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# Sport Fishery Abstracts

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# DEPARTMENT OF THE INTERIOR

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### U. S. FISH AND WILDLIFE SERVICE

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# Sport Fishery Abstracts

**An abstracting service for fishery research and management**

Vol. 8, No. 3 Abstracts 5833 - 6032 July 1963

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Branch of Federal Aid
M. A. Marston, Chief
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**5833.** Lambou, Victor W. (Louisiana Wild Life and Fish. Comm., Baton Rouge). 1963. APPLICATION OF DISTRIBUTION PATTERN OF FISHES IN LAKE BISTINEAU TO DESIGN OF SAMPLING PROGRAMS. Prog. Fish-Cult. 25(2): 79-87.

Undoubtedly, the individuals of the various species of fish occurring in Lake Bistineau are distributed according to some type of contagious distribution. It is believed that possibly the negative binomial would approximate the distribution, and that Fisher's logarithmic distribution could account for the distribution of species and number of individuals of each. If the probability distribution of the number of individuals in random samples is the negative binomial, estimates based on the smallest possible sampling units will be the most precise if the sampling fraction remains fixed, but if the number of samples is independent of the size of the sampling unit, estimates based on the largest possible sampling units will be the most precise. However, in sampling fish populations, it is possible that even though the number of samples remains the same, an increase in the size of the sampling unit will not increase the precision enough to be of much practical value. It is extremely unlikely that sampling fish populations with rotenone, or with most types of gear, will fit either of the above two conditions exactly. Though it is impossible to give any definite recommendations as to size of sampling unit, these factors should be considered in designing sampling programs. (Auth.)

**5834.** Rodman, Duane T. (U. S. Bur. Comm. Fish., Seattle, Washington). 1963. ANESTHETIZING AND AIR-TRANSPORTING YOUNG WHITE STURGEONS. Prog. Fish-Cult. 25(2): 71-78.

A report of the procedures followed and the results obtained in the preparation for air transportation of young white sturgeons (Acipenser transmontanus) from Seattle, Washington, to Kobe, Japan. Tricaine methanesulfonate (M.S. 222) and tertiary amyl alcohol were tested, and sturgeons proved to be intolerant to the concentrations used. Cold, induced with $CO_2$ ice, was successfully used to provide sedation during air transportation. (Auth.)

**5835.** Tennant, Donald L. (U. S. Bur. Sport Fish. and Wildl., Grand Island, Nebraska), and George Billy. 1963. ARTIFICIAL HYBRIDIZATION OF THE MUSKELLUNGE AND GRASS PICKEREL IN OHIO. Prog. Fish-Cult. 25(2): 68-70.

Male muskellunge (Esox masquinongy) were successfully crossed with female grass pickerel (Esox americanus vermiculatus), and the vigorous hybrids were reared to an average size of 11.5 in. and 5.5 oz. in 6 months. The hybrids were heavier bodied than either a muskellunge or grass pickerel of similar length. At 18 months some of the hybrids were 16 in. long and weighed more than 1 lb. Stomach analysis revealed that one hybrid had ingested many dragonfly nymphs along with other invertebrates. This differed markedly from the almost exclusively piscivorous feeding habits of fingerling muskellunge in Ohio. This fish may be short-lived as well as highly susceptible to harvest by angling, since various followup attempts failed to produce any evidence of surviving hybrids in the pond in which they were released. There was some indication that the hybrid might be desirable as a predator species in ponds or small lakes. (Authors)

**5836.** Eschner, Arthur R. (U. S. Forest Serv., Upper Darby, Pennsylvania), and Jack Larmoyeux. 1963. LOGGING AND TROUT: FOUR EXPERIMENTAL FOREST PRACTICES AND THEIR EFFECT ON WATER QUALITY. Prog. Fish-Cult. 25(2): 59-67.

Four forest practices, ranging from a commercial clearcut to a light selection cut, were applied to watersheds on the U. S. Forest Service's Fernow Experimental Forest in 1957-58. Streamflow increases were most pronounced in the growing season and fell into a logical pattern with timber volume cut. In May to October 1959, increases of 3.0, 1.8, 1.4, and 0.3 area-inches of streamflow came from watersheds having 8.5, 4.2, 3.7, and 1.7 thousand board-feet per acre cuts, respectively. Maximum turbidities ranged from 56,000 ppm on the watershed with unplanned skidroads to 25 ppm on the watershed with carefully planned skidroads. Average growing-season maximum stream temperature was 8° higher on the clearcut watershed than on the untreated control. Alkalinity, pH, and specific conductance of the water from this heavily cut drainage area were also higher than like characteristics of the control. Moderate cutting did not result in perceptible differences in water quality which might be important in trout management. Effects of treatment on streamflow and turbidity are diminishing with vegetative recovery and natural soil stabilization. (Authors)

**5837.** Ashley, Laurence M., and Charlie E. Smith (U. S. Bur. Sport Fish. and Wildl., Cook, Wash.). 1963. ADVANTAGES OF TISSUE IMPRINTS OVER TISSUE SECTIONS IN STUDIES OF BLOOD CELL FORMATION. Prog. Fish-Cult. 25(2): 93-96.

The superiority of tissue imprints (impression films) over tissue sections for the study of salmonid hemopoiesis is discussed and illustrated by 5 photomicrographs. A detailed description of the methods of preparing tissue imprints for staining by fixation over formaldehyde fumes, and of double staining them in buffered Wright's (or May-Grunwald's) followed by Giemsa's, is also presented. Pertinent literature is cited. (Authors)

**5838.** Taube, Clarence M. (Michigan Dept. of Cons., Ann Arbor). 1963. A LIBRARY SYSTEM. Prog. Fish-Cult. 25(2): 101-103.

A system of indexing and filing library material is described. The method is applicable to a personal, utilitarian library in which the publications relate to a particular area of knowledge, e.g., fish and fisheries. References are cataloged on the basis of subject topics on 3- by 5-in. cards, a number of references being recorded on a single card. A separate index is prepared for each journal represented

in the library, and one also for independent publications and reprints of papers that have appeared. (Auth.)

**5839.** Warren, James W. (U. S. Bur. Sport Fish. and Wildl., Cook, Wash.). 1963. TOXICITY TESTS OF ERYTHROMYCIN THIOCYANATE IN RAINBOW TROUT. Prog. Fish-Cult. 25(2): 88-92.

Four toxicity experiments, employing 3 dosage levels of erythromycin thiocyanate, were conducted with rainbow trout (Salmo gairdneri). A dosage of 500 mg/kg/day, 5 times the usual therapeutic level, was required to produce overt symptoms of toxicity. The appearance of these symptoms could not be avoided by the administration of iodine in conjunction with the drug. No obvious symptoms of toxicity could be produced by feeding drug-treated diets at 2 lower levels. (Auth.)

**5840.** Parvin, John, and Marvin A. Smith (U. S. Bur. Sport Fish. and Wildl., Portland, Oregon). 1963. SALMON AND STEELHEAD RUNS AT THE EAGLE CREEK NATIONAL FISH HATCHERY. Prog. Fish-Cult. 25(2): 97-100.

In the 5 years of its operation, this hatchery has been notably successful in the artificial propagation of 3 species of anadromous fish. This success has been measured not just in pounds of fish produced but also by the number of adults returning to the hatchery after running the gamut of the intensive sport and commercial fisheries. Exceptional runs of steelhead trout (Salmo gairdneri) and coho salmon (Oncorhynchus kisutch) have been built up, and what may be considered a new run of chinook salmon (O. tshawytscha) has been established. (Authors)

**5841.** Gleason, Gale R., and F. G. Goff (Central Michigan Univ., Mt. Pleasant). 1963. A MULTI-LEVEL WATER SAMPLER. Prog. Fish-Cult. 25 (2): 104-105.

The multi-level water sampler (M. L. S.) was developed to meet the need for differential water samples at intervals of less than 1/2 meter. The M. L. S. takes eight, 125 ml samples at intervals of 2 cm or multiples thereof. Special features have been developed for the analysis of dissolved oxygen. An aspirator ampule mixes the fixing solutions at the depth at which the sample is taken. The M. L. S. is compact and is lowered and tripped by the same methods used for most limnological samplers. (Authors)

**5842.** Franklin, Donald R., and Lloyd L. Smith, Jr. (Dept. of Entomology, Fisheries, and Wildlife, Univ. of Minnesota, St. Paul). 1963. EARLY LIFE HISTORY OF THE NORTHERN PIKE, ESOX LUCIUS L., WITH SPECIAL REFERENCE TO THE FACTORS INFLUENCING THE NUMERICAL STRENGTH OF YEAR CLASSES. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 91-110.

The early life history of northern pike was studied to determine the relationship of adult pike abundance to the strength of resulting year classes and the existence and chronology of critical survival periods, along with the nature and origin of the mortality mechanisms involved. Adult abundance and the strength of the resulting year classes were not directly related. Two critical survival periods were located, one during the embryo stage between fertilization and closure of the blastopore, and the second between hatching and the termination of the alevin stage. The mortality during these periods may result from toxic concentrations of iron compounds or from excessively rapid temperature change. Growth, food utilization, and oxygen, ammonia, and sulfide levels in the nursery slough did not appear to influence survival. Greatest survival of naturally reared fingerlings will result from stabilization of water levels in the nursery areas. Water is required for at least 3 months after egg deposition if the best survival is to be obtained. (Authors)

**5843.** Anonymous (Fish. Div., Biol. Br., Food and Agric. Organiz. of the United Nations, Rome, Italy). 1962. A WORLD LIST OF EXPERTS CONCERNED WITH THE STUDY OF THE BIOLOGY OF TUNAS AND RELATED SPECIES. FAO Fisheries Biology Technical Paper No. 10, 26 pp.

**5844.** Lahav, M., M. Shilo (Hebrew University, Hadassah Medical School, Jerusalem), and S. Sarig. 1962. DEVELOPMENT OF RESISTANCE TO LINDANE IN ARGULUS POPULATIONS OF FISH PONDS. Bamidgeh, Vol. 14, No. 4, pp. 67-76.

A survey of lindane treated ponds all over the country showed that Argulus populations exhibit great variability in their resistance to lindane.

A definite correlation between the number of lindane treatments given to a pond and the measure of lindane resistance of the Argulus population of the pond was established.

The resistance developed by Arguli through lindane treatments is equally effective against other chlorinated insecticides such as endrin.

Lindane treatments of Arguli do not lead to the development of resistance to malathion, a phosphorus compound. (Authors)

**5845.** De Sylva, Donald P., and William P. Davis (Inst. of Marine Sci., Univ. of Miami, Miami 49, Florida). 1963. WHITE MARLIN, TETRAPTURUS ALBIDUS, IN THE MIDDLE ATLANTIC BIGHT, WITH OBSERVATIONS ON THE HYDROGRAPHY OF THE FISHING GROUNDS. Copeia, 1963, No. 1, pp. 81-99.

In the summers of 1959 and 1960, data from 245 white marlin examined between Atlantic City, New Jersey and Ocean City, Maryland, were compared with specimens from other Atlantic regions. Peaks in the weight-frequency distributions suggest that this is a relatively long-lived fish. Population dynamics are discussed. Weights of males in the study area ranged from 26 to 64 pounds, that of

females 36 to 114 pounds. There is a sexual difference in the length-weight relation, and the sex ratio is unequal. Marlin taken during the summer fishery have ceased spawning. Important items of food are squid (Loligo pealei), round herring (Etrumeus sadina), and carangid fishes. Hydrographic features of the fishing grounds are analyzed and are thought to be areas of high plankton concentrations. Thermocline structure and bottom topography are important in the formation of a thermal dome which in turn may act as a plankton trap and attractant to food organisms of marlin. (Authors)

5846. Barlow, George W. (Dept. of Zool., Univ. of Illinois, Urbana). 1963. SPECIES STRUCTURE OF THE GOBIID FISH GILLICHTHYS MIRABILIS FROM COASTAL SLOUGHS OF THE EASTERN PACIFIC. Pacific Science, Vol. XVII, No. 1, pp. 47-72.

Gillichthys mirabilis Cooper is found in coastal sloughs from Central California south to near Cabo San Lucas, and then again in the central and northern parts of the Gulf of California. It has been introduced into the Salton Sea.

The fish spawn from about January to June and reach maturity within 1 year. The larvae have a brief pelagic phase, during which time the species is distributed to new habitats.

The head is shortest in specimens of mirabilis from the Salton Sea and most depressed in those from the Gulf of California. The length of the upper jaw and the height of the median fins are greatest in samples from the Gulf and least in those from the Salton Sea. Specimens from the upper Gulf region have the dorsal fins separated more than in mirabilis from elsewhere.

The scales are larger and the ventral area more scaled in specimens from the Gulf than in those from the outer coast. Scalation is noticeably reduced in fish from the Salton Sea.

Trends in means of meristic characters, from north to south along the Pacific Coast, and then from south to north up into the Gulf of California, are as follows: spiny dorsal fin--no change or slight increase; segmented rays of median fins--decrease; pectoral fin--increase; combined fin elements--irregular or no change; fin index (segmented dorsal plus anal rays, divided by pectoral rays, times 100)--decrease; pectoral fin asymmetry--decrease; vertebrae--no change.

The variance of the number of elements in each fin is a function of latitude, greater variance being associated with higher latitudes.

The means of the counts of the median fin are negatively correlated with the means for pectoral fin rays when the comparison is between the various populations. In successive year classes within a given population, however, changes in the number of rays in the median fins are associated with commensurate changes of the same sign in the counts of the pectoral fin rays. But within each year class there is no correlation between the number of pectoral fin and median fin rays.

All meristic characters have higher mean values in specimens from the Salton Sea, but the mean of their fin index accords with the Pacific Coast population from which they were derived. The Salton Sea fish are aberrant in many ways, evidently as a result of living in a marginal environment. (Auth.)

5847. Southward, A. J. (The Plymouth Lab., Devonshire, England). 1963. THE DISTRIBUTION OF SOME PLANKTON ANIMALS IN THE ENGLISH CHANNEL AND APPROACHES. III. THEORIES ABOUT LONG-TERM BIOLOGICAL CHANGES, INCLUDING FISH. Journal of the Marine Biological Association of the United Kingdom, Vol. 43, No. 1, pp. 1-30.

Various biological and environmental changes that have been observed during the present century in the area of the western English Channel are briefly described, and then theories that have been put forward to account for them discussed and compared critically with one another.

At the moment, the rise in sea temperature and a possible accompanying change in emphasis of water movements offers the best explanation of all the changes. Such a theory is obviously applicable to the replacement of cold-water northern forms by warmer-water species that has taken place in many habitats (e. g. demersal fishes, pelagic fishes, intertidal zone). A decline in number of macroplankton animals, including the pelagic young of some demersal fish, can be regarded as another aspect of the temperature change, in part related to a shift in distributional boundaries, but also influenced by the replacement of herring by pilchard, which has apparently led to increased stocks of pelagic fish, and perhaps a higher level of predation throughout the year. It is suggested that the plankton production cycle may have become slightly smoother, and possibly a little more efficient, with less 'wastage' to the bottom-fauna, the biomass of which may also have suffered indirectly from the increased stocks of pelagic fish. (Auth.)

5848. Baggerman, Bertha (Zool. Lab., Univ. of Groningen, Haren (Gr.), Netherlands). 1962. THE EFFECT OF TSH AND ANTITHYROID SUBSTANCES ON SALINITY PREFERENCE AND THYROID ACTIVITY IN JUVENILE PACIFIC SALMON. Canadian Journal of Zoology, Vol. 41, No. 2, pp. 307-319.

Underyearling coho salmon treated with TSH showed a change from fresh- to salt-water preference, which was correlated with an increase in thyroid activity (as measured by the amount of radioiodine taken up by the gland and the conversion ratio).

Underyearling pink salmon treated with thiourea showed a change from salt- to fresh-water preference, which was accompanied by a decrease in thyroid activity. In this species treatment with thiouracil and sodium thiocyanate also induced a change from salt- to fresh-water preference.

It is concluded that the secretory activity of the thyroid gland is intimately involved in the

induction of changes in salinity preference, which, in their turn, are closely associated with the onset and end of the migration season. (Auth.)

**5849.** Bagenal, T. B. (The Marine Station, Millport, England). 1963. THE FECUNDITY OF PLAICE FROM THE BAY OF BISCAY. Journal of the Marine Biological Association of the United Kingdom, Vol. 43, No. 1, pp. 177-179.

Summary of Plaice Fecundity Data

| | LaRochelle | Plymouth | North Sea |
|---|---|---|---|
| No. fish | 63 | 64 | 223 |
| Mean length(cm) | 40.89 | 42.47 | 37.13 |
| Mean age | 2.79 (47 fish) | 6.3 | 7.3 |
| Mean fecundity | 249,060 | 212,769 | 84,928 |
| $\hat{F}$ for 37 cm | 184,077 | 137,470 | 84,019 |

**5850.** Bagenal, T. B. (The Marine Station, Millport, England). 1963. THE FECUNDITY OF ICELANDIC PLAICE. Journal of the Marine Biological Association of the United Kingdom, Vol. 43, No. 1, pp. 181-183.

Summary of Icelandic Plaice Fecundity Data

| | | | |
|---|---|---|---|
| Number of fish | 38 | Mean fecundity | 345,447 |
| Mean length(cm) | 51.64 | $\hat{F}$ for 37 cm | 105,800 |
| Mean weight(g) | 1304.5 | | |

**5851.** Davis, Gerald E., Jack Foster, Charles E. Warren, and Peter Doudoroff (Dept. of Fish and Game Mgmt., Oregon State Univ., Corvallis). 1963. THE INFLUENCE OF OXYGEN CONCENTRATION ON THE SWIMMING PERFORMANCE OF JUVENILE PACIFIC SALMON AT VARIOUS TEMPERATURES. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 111-124.

The sustained swimming speeds of juvenile coho and chinook salmon tested in a tubular chamber at temperatures ranging from 10 to 20° C usually were dependent on the dissolved oxygen concentration at any tried concentration below the air-saturation level. Some underyearling chinook salmon tested at 19.5° C were notably exceptional; their performance at high oxygen concentrations was not markedly better than that observed at lower concentrations between 5 and 7 mg/l. These fish may have been anemic. Reduction of oxygen concentration from air-saturation levels to 7, 6, 5, 4, and 3 mg/l usually resulted in reduction of the maximum sustained swimming speed of coho salmon by about 5, 8, 13, 20, and 30 percent, respectively. These percentages are based on the observed performance of the first-failing and second-failing individuals of a group of five fish used in a performance test. The corresponding estimated percent reductions of the swimming speed of first-failing fish in most of the early exploratory experiments with chinook salmon were somewhat greater, averaging approximately 10, 14, 20, 27, and 38 percent, respectively. Within the ranges of tested concentrations above the saturation levels, variations of oxygen concentration had little or no effect on the performance of wild underyearling and hatchery-reared yearling coho salmon. The performance of the wild underyearlings at tested oxygen concentrations improved progressively with increase of temperature from 10 to 15 and to 20° C. (Authors)

**5852.** Ferguson, Robert G., and Henry A. Regier (Ontario Dept. of Lands and Forests, Wheatley, Ontario, Canada). 1963. SELECTIVITY OF FOUR TRAWL COD ENDS TOWARD SMELT. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 125-131.

Three short-term experiments on selectivity of cod ends with various mesh sizes for smelt, Osmerus mordax (Mitchill), were conducted in Lakes Ontario and Erie during 1961. In each experiment the paired tow method was used. Four cod ends were attached alternately to a "Western bottom trawl" fished by the MV Erie I. Estimates of percent retention within 0.3-inch length strata were obtained from a comparison of length-frequency distributions in catches made by the different cod ends fishing approximately the same population of smelt on the same date. Additional information was gained from the weight of catches by different cod ends.

Under the conditions of the experiment, cod end mesh sizes of 1 3/16 to 1 3/8 inches appeared most suitable for smelt trawling given market preferences as they existed in October 1961. (Authors)

**5853.** Eipper, Alfred W. (Dept. of Cons., Cornell Univ., Ithaca, New York). 1963. EFFECT OF HATCHERY REARING CONDITIONS ON STREAM SURVIVAL OF BROWN TROUT. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 132-139.

Groups of brown trout (Salmo trutta) which had experienced normal and temperature-retarded growth in the hatchery were stocked in a 5-mile section of Fall Creek, New York, to compare their natural mortality rates during the season directly following spring stocking. "Normal" trout were reared in Cortland, New York, hatchery water averaging 54° F and varying annually from 39 to 60° F; "retarded" trout were reared in a different water supply at Cortland which remained at approximately 47° F year-round. Observations on movement (from tag returns), rates of exploitation (from creel census), and total mortality (from electrical inventories in June and September) provided the data needed to compute natural mortality rate (n) of each experimental lot in the first and second parts of both the 1949 and 1950 seasons. Yearling and 2-year-old retarded trout usually had higher natural mortality than did yearling normals in both parts of both seasons. The higher mortality rates among the retarded trout were particularly evident in the second parts of the seasons, when higher water temperatures prevailed. At time of stocking in 1949, yearling normals had harder body fat (lower iodine number) than the yearling retarded trout. In a 6-week test in Cascadilla Creek in the spring of 1951, yearling normals again had lower natural mortality than yearling retarded trout, although water

temperatures never became critically high. These findings suggest that characteristics of the hatchery water supply can influence natural mortality rate of brown trout after stocking. High-temperature acclimation may be one component of this influence, but apparently it is not the only component. (Auth.)

**5854.** Logan, Sidney M. (Alaska Dept. of Fish and Game, Seward, Alaska). 1963. WINTER OBSERVATIONS ON BOTTOM ORGANISMS AND TROUT IN BRIDGER CREEK, MONTANA. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 140-145.

Effects of temperature, ice, and fluctuating water levels on bottom organisms and on the movements of rainbow trout were investigated in a 900-foot section of Bridger Creek in southwestern Montana from October 21, 1959, to September 12, 1960. Ninety-six bottom samples and 27 drift samples were studied. Limnephilidae were the most abundant aquatic organisms in the area. Surface ice cover had no effect on the abundance of bottom organisms except for the loss of a small number frozen in the ice at the stream edge. High flows during the spring reduced the number of bottom organisms in situ, and increased the number taken in drift samples. Floating surface ice did not appear to increase the number of organisms in drift samples.

Sixty-one percent of the trout captured and tagged in the study section were recaptured no more than 150 feet from the original place of capture. More trout were recovered downstream than upstream during each month of study. Trout moved as far as 2 miles upstream from the study section, and 55 miles downstream. During the spring, summer, and autumn, trout were mainly found in pools, while in winter many were collected in riffle areas under surface ice. (Auth.)

**5855.** Northcote, T. G., and D. W. Wilkie (British Columbia Dept. of Recreation and Conservation, Fish and Game Br., Vancouver, B. C., Canada). 1963. UNDERWATER CENSUS OF STREAM FISH POPULATIONS. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 146-151.

Variability and reliability of counts of fish made by divers in sections of two British Columbia rivers are examined. Repeated counts of several species of fish by a team of divers in a stream section are reasonably homogeneous, and not markedly different from total numbers subsequently recovered by poisoning. Diver counts of large spawning rainbow trout also agree closely with those made in areas with good visibility from the river bank or from helicopter. Under suitable conditions a diver team can rapidly census the fish population of long stretches of stream and obtain estimates of species composition and abundance in types of habitat difficult or impossible to sample by usual methods. (Authors)

**5856.** Surber, Eugene W., and Thomas O. Thatcher (Robt. A. Taft Sanit. Engng. Center, Cincinnati, Ohio). 1963. LABORATORY STUDIES OF THE EFFECTS OF ALKYL BENZINE SULFONATE (ABS) ON AQUATIC INVERTEBRATES. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 152-160.

Experimental equipment, methods, and results of a number of experiments with stream bottom animals to determine the toxic effects of a packaged detergent containing 27 percent alkyl benzene sulfonate (ABS) are described.

Most experiments were carried out in oval, metal tanks 3 feet long with channels 5 inches deep and 4 1/2 inches wide placed side by side. Currents simulating those found in streams were produced in the tanks with paddle wheels operated from a common shaft turned by a laboratory mixer. Each tank had a flow of 100 ml per minute. ABS was supplied from reservoirs to produce concentrations of 4, 8, 16, and 32 ppm in the water of the tanks. Actual concentrations present were determined twice weekly by a methylene blue method. In general, mayfly nymphs (Stenonema ares, S. heterotarsale, Isonychia bicolor) were killed by 10 days' exposure to ABS at 16 ppm or more, and reduced in numbers by 8 ppm. Hydropsychidae larvae were more resistant, and in several experiments considerable numbers survived 10-day exposures at 32 ppm. Crayfish (Orconectes rusticus), freshwater shrimp (Synurella sp.), and sow bugs (Lirceus sp.) were seriously reduced in numbers by exposure to 10 ppm ABS over a period of 2 weeks or more, but a snail (Goniobasis sp.) was apparently unaffected by this concentration. (Authors)

**5857.** Warner, Kendall (Maine Dept. of Inland Fish. and Game, Ashland). 1963. NATURAL SPAWNING SUCCESS OF LANDLOCKED SALMON, SALMO SALAR. Transactions of the American Fisheries Society, Vol. 92, No. 2, pp. 161-164.

During 1959-61, 33 landlocked salmon redds containing 24, 712 eggs were excavated in two spawning areas of the Fish River Lakes to evaluate survival of naturally spawned eggs. Depth of egg deposition averaged 8 inches and ranged from 4 to 12 inches below the redd surface. The average number of eggs per redd was 749. Total egg survival to the late eyed stage averaged 93.2 percent. Average egg mortality was 4.2 percent in the pre-eyed stage and 1.7 percent in the eyed stage. Loss due to nonfertilization was less than 1 percent. Analysis of the texture of redd materials showed that 75 percent were larger than 0.25 inch, and only 12-14 percent were larger than 1.5 inches. Sand comprised 16-17 percent of the redd materials. Egg survival was apparently not affected by the amount of sand, silt, and clay in redd materials. High survival of salmon eggs in the area studied is favored by a relatively stable stream flow and lack of severe ice conditions. Superimposition of redds is not considered to be a serious factor in egg mortality. (Auth.)

**5858.** Bagenal, T. B. (The Marine Station, Millport, England). 1963. PROPYLENE PHENOXETOL AS

A FISH ANESTHETIC. Nature, Vol. 197, No. 4873, pp. 1222-1223.

From the experiments it is concluded that, for anesthetizing fish for a period of more than 3 h, propylene phenoxetol must be used with great care since the strength of the solution and the temperature are critical. On the other hand, the experiments also show that it is a useful anesthetic for periods of up to 1 h when a solution of 0.01-0.025 percent can be used at normal laboratory and aquarium temperatures with fish of a wide range in size. (Auth.)

5859. Wetzel, Robert G. (Dept. of Zool., Indiana Univ., Bloomington). 1963. PRIMARY PRODUCTIVITY OF PERIPHYTON. Nature, Vol. 197, No. 4871, pp. 1026-1027.

Hitherto the contribution of the littoral producers to the total photosynthetic carbon fixation has generally been regarded as insignificant as compared with that of the phytoplankton. Neglect of the sessile producers is perhaps warranted in certain large, deep lakes. However, the periphyton and macrophytes constitute a major or, perhaps, the predominant source of photosynthetic energy fixation in many shallow lakes, ponds, marshes, and rivers. (Auth.)

5860. McCann, James A., and Frank A. Dreyer (Bur. Comm. Fish., Woods Hole, Massachusetts). 1963. LENGTH AND AGE FREQUENCY SAMPLES COLLECTED FROM GEORGES BANK HADDOCK LANDINGS, 1931-55. Special Scientific Report--Fisheries No. 438, 127 pp.

The development of the North Atlantic haddock investigation is briefly reviewed, and the methods used to collect length frequency and scale sample data are discussed. These sample data are presented in 125 tables. (Authors)

5861. McCann, James A., and Frank A. Dreyer (Bur. Comm. Fish., Woods Hole, Massachusetts). 1963. LENGTH AND AGE FREQUENCY SAMPLES COLLECTED FROM GEORGES BANK AND GULF OF MAINE HADDOCK LANDINGS, 1956-1960. Special Scientific Report--Fisheries No. 439, 113 pp.

The expansion in 1956 of the North Atlantic haddock investigation is discussed, and 100 tables containing the length and age frequency samples collected from the 1956-60 Georges Bank and Gulf of Maine commercial haddock landings are presented. (Authors)

5862. Squire, James L., Jr. (Tiburon Marine Lab., Bur. of Sport Fish. and Wildl., Tiburon, California). 1962. DISTRIBUTION OF TUNAS IN OCEANIC WATERS OF THE NORTHWESTERN ATLANTIC. U. S. Fish and Wildlife Service, Fishery Bulletin 211, Vol. 62, 20 pp.

Exploration of the oceanic northwest Atlantic adjacent to the Continental Shelf of North America indicates that major populations of bluefin tuna exist along the northern edge of the central Gulf Stream axis in winter and spring. Species dominance, in the oceanic area explored, changes from bluefin tuna to yellowfin tuna during summer and early fall. Commercial concentrations of bluefin and yellowfin tunas were present offshore in addition to minor concentrations of albacore, bigeye tuna, and skipjack. (Auth.)

5863. Bainbridge, Richard (Zoological Laboratory, Cambridge, England). 1962. CAUDAL FIN AND BODY MOVEMENT IN THE PROPULSION OF SOME FISH. The Journal of Experimental Biology, Vol. 40, No. 1, pp. 23-56.

It is concluded that the fish has active control over the speed, the amount of bending and the area of the caudal fin during transverse movement.

The bending of the fin and its changes in area are considered to be directed to the end of smoothing out and making more uniform what would otherwise be an intermittent thrust from the oscillating tail region.

Some assessment is made of the proportion of the total thrust contributed by the caudal fin. This is found to vary considerably, according to the form of the lateral propulsive movements of the whole body, from a value of 45% for the bream to 84% for the dace. (Auth.)

5864. Weatherly, A. H. (Zool. Dept., School of General Studies, Australian National Univ., Canberra, A. C. T.). 1961. A NOTE ON THE HEAD KIDNEY AND KIDNEY OF THE PERCH PERCA FLUVIATILIS (LINNAEUS), WITH SPECIAL REFERENCE TO THE BLOOD VASCULAR SYSTEM. Proceedings of the Zoological Society of London, Vol. 140, Part 2, pp. 161-167.

A brief account is given of the morphology, internal structure and blood vascular system of the head kidney and kidney of the perch. The cardinal anterior and posterior veins pursue an odd course through the head kidney, and the interrenal tissue occurs within the head kidney particularly around the junction of these veins. The bulk of the head kidney, as in most teleosts, is a mass of lymphoid tissue. The blood vessels associated with the kidneys have an essentially segmental arrangement, as have the kidneys themselves. However, some arteries given off from the aorta traverse the kidneys without further branching on the way to the body wall. Others supply the kidneys themselves with blood and are true renal arteries. At least three-quarters of the blood from the kidneys, body wall, cardinal vein, etc., is carried by the right posterior cardinal vein, due to the degenerate condition of the left posterior cardinal. There appears to be a renal portal system with veins from the body wall joining with those in the kidney via venous plexuses. (Auth.)

5865. Shelbourne, J. E. (Ministry of Agric., Fish. and Food., Fish. Lab., Lowestoft, England). 1963. A MARINE FISH-REARING EXPERIMENT USING ANTIBIOTICS. Nature, Vol. 198, No. 4875, pp. 74-75.

At all temperatures, a higher percentage hatch occurred in tanks treated with antibiotics.

Slight differences in survival between treated and untreated egg stocks were magnified during larval feeding, at all temperatures, indicating that the benefits of bacterial control during incubation are felt long after hatching is complete.

The 'critical period' between hatching and first-feeding, so long a controversial topic among marine fish culturists, may, after all, be the consequence of artificial hazards in the tank environment. A 'critical period' will still occur in the sea, however, if suitable planktonic food is scarce during the early larval stages. (Auth.)

**5866.** Klawe, Witold L., Izadore Barrett, and Barbara M. Hillsdon Klawe (Inter-American Tropical Tuna Commission, Scripps Inst. of Oceanogr., La Jolla, California). 1963. HEMOGLOBIN CONTENT OF THE BLOOD OF SIX SPECIES OF SCOMBROID FISHES. Nature, Vol. 198, No. 4875, pp. 96-97.

The hemoglobin concentrations are, on the whole, higher for the six scombroids than for other groups of fishes, as reported in the literature. Further, the concentrations are higher in the blood of the yellowfin tuna, skipjack, black skipjack, and frigate mackerel than in the blood of the Pacific mackerel and the Pacific bonito. The higher hemoglobin content of the blood of the former four species may somehow be related to their highly developed cutaneous vascular system, an anatomical feature absent in the latter two species. (Authors)

**5867.** Patten, Bernard C., Richard A. Mulford, and J. Ernest Warinner (Virginia Inst. of Marine Science, Gloucester Point, Virginia). 1963. AN ANNUAL PHYTOPLANKTON CYCLE IN THE LOWER CHESAPEAKE BAY. Chesapeake Science, Vol. 4, No. 1, pp. 1-20.

An annual phytoplankton cycle in lower Chesapeake Bay, Virginia, is described based on data obtained in 1960 on 24 cruises to five stations.

Diatoms were dominant in winter while flagellates were more important during warm periods and late autumn. Both groups were of comparable significance, generally, with flagellates being somewhat more important in the York River and diatoms in the bay proper.

There were four periods of population maxima and six peaks of species diversity. Diversity appeared to spread upbay from the sea during cold periods and downbay from the rivers during warm seasons.

Highest mean population and diversity levels occurred on the western side of the estuary where discharges from several major river systems are received. Despite this indication that environment controls long-term levels of abundance, it could not be demonstrated that nutrients or other specific factors mediated the annual cycle. (Authors)

**5868.** Hoffman, Roger A. (Physiology Div., U.S. Army Chem. Res. and Devel. Lab., U. S. Army Edgewood Arsenal, Maryland). 1963. GONADS, SPERMATIC DUCTS, AND SPERMATOGENESIS IN THE REPRODUCTIVE SYSTEM OF MALE TOADFISH, OPSANUS TAU. Chesapeake Science, Vol. 4, No. 1, pp. 21-29.

The testes of Opsanus tau are paired, elongated organs lying along the dorsal body wall. They are drained by a series of spermatic ducts which remain separate throughout their length and which empty their contents into the cloaca via a small genital papilla. Spermatogenesis occurs cyclically within cysts which line the testis tubules. Maturation and division occur simultaneously in all of the cells within the cyst. Six distinct stages of spermatogenesis have been recognized and described. With phase microscopy, sperm differentiation was investigated and described. Two tails are characteristic of the sperm of this species.

Seasonal variations in the spermatogenic cycle occur. Animals within the same month, however, also show considerable variation. Prior to the breeding season, the tubules are filled with masses of stored sperm and the cysts are small and inactive. During the breeding season, the tubules become empty of sperm and this is rapidly followed by a reactivation of spermatogenesis with a subsequent increase in luminal spermatozoa. (Auth.)

**5869.** Hoffman, Roger A. (Physiology Div., U. S. Army Chem. Res. and Devel. Lab., U. S. Army Edgewood Arsenal, Maryland). 1963. ACCESSORY GLANDS AND THEIR DUCTS IN THE REPRODUCTIVE SYSTEM OF THE MALE TOADFISH, OPSANUS TAU. Chesapeake Science, Vol. 4, No. 1, pp. 30-37.

The accessory genital glands of Opsanus tau are large fan-shaped organs lying in the posterior region of the abdominal cavity. Four distinct parts on each side can be recognized grossly and microscopically by virtue of morphology, color, secretion granules, and vascularity. All four parts have separate collecting ducts which drain into the paired spermatic ducts as they course posteriorly to exit into the cloaca via a grooved genital papilla. Seasonal changes in the gross and microscopic anatomy of the accessory glands are described. (Auth.)

**5870.** Massmann, William H. (Sport Fishing Inst., Washington, D. C.). 1963. AGE AND SIZE COMPOSITION OF WEAKFISH, CYNOSCION REGALIS, FROM POUND NETS IN CHESAPEAKE BAY, VIRGINIA, 1954-1958. Chesapeake Science, Vol. 4, No. 1, pp. 43-51.

Lengths of 14, 508 weakfish from pound-net catches in Chesapeake Bay during the 1954-58 period showed little variation from year to year; nodal lengths ranged from 220 to 235 mm. Spring catches included larger fish than were taken in summer and fall. Age composition, based on scale samples from 4, 516 fish, changed little from year to year and was estimated as: 62 percent, 1-year olds; 28 percent, 2-year olds; 8 percent, 3-year olds; and 1 percent, 4-year olds. Two- and 3-year old fish dominated spring catches, 1-year old the summer and fall

catches. Annual catch per net ranged from 50,000 to 70,000 pounds. In some months almost half of the catch was utilized as scrap. A single year class (1955) contributed about 200,000 fish per net. Before conclusions may be drawn concerning fishing mortality or the effect of the Virginia fishery on weakfish stocks further north, the complex migratory patterns of weakfish must be more clearly known. (Auth.)

5871. Massmann, William H. (Sport Fishing Inst., Washington, D. C.). 1963. ANNULUS FORMATION ON THE SCALES OF WEAKFISH. CYNOSCION REGALIS, OF CHESAPEAKE BAY. Chesapeake Science, Vol. 4, No. 1, pp. 54-56.

Annulus formation and scale growth were studied on scale samples from 3624 weakfish from Chesapeake Bay during the period from April to October. Annuli formed on the scales of yearling weakfish from April to August. In older weakfish most annuli were formed in June and July. Scale growth after annulus formation appeared to be rapid for a short period after which its rate declined. The combination of annulus formation during the peak of the fishing season followed by accelerated scale growth complicates age determination based on scale samples alone. (Auth.)

5872. Gerbil'skii, N. L. 1961. THE ANALYSIS OF THE PROPERTIES AND THE RELATIONSHIP OF HISTOLOGICAL AND ANATOMIC STRUCTURES IN SPECIAL EVOLUTION AND ITS IMPORTANCE FOR HISTOLOGICAL EVOLUTION. (ANALIS OSOBENNOSTEI I VZAIMOSVYAZEI GISTOLOGICHESKYKH I ANATOMICHESKYKH STRUKTUR V PROTSESSE EVOLYUTSII VIDA I EGO ZNACHENIE DLYA EVOLYUTSIONNOI GISTOLOGII.) Kharkov. 1: 543-547; Referat. Zhur., Biol., 1962, No. 1518; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4064. 1963.

Embryologic and histologic data are used to refute the popular theory of the phylogenetic similarity between cartilaginous and bony fish. It is concluded that the cartilaginous fish are closer to the amphibians than to the bony fish. Cartilaginous fish are not considered to be the precursors of the bony fish.

5873. Ivlev, V. S., and V. M. Ivasik. 1961. DATA ON BIOLOGY OF MOUNTAIN RIVERS OF SOVIET CARPATHIAN RUTHENIA. (MATERIALY PO BIOLOGII GORNYKH REK SOVOTSKOGO ZAKARPAT'YA.) Trudy Vses. Gidrobiol. Obshch. 11. 171-188; Referat. Zhur., Biol., 1962, No. 14Zh511; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4752. 1963.

The mountain streams of Carpathian Ruthenia assume the status of fish industry reservoirs, since they are the habitat of Salmonidae: Salmo irideus, S. trutta fario, Hucho and Thymallus. The article gives a geographical and hydrological characterization. It also describes the methodology of quantitative sampling of benthos, using a benthometer as modified by V. S. Ivlev. The material was collected at 148 stations. The species structure, quantity (biomass 2 to 25 g/$m^2$) and ecological characteristics of benthos are given. The fish population of the rivers consists of 45 species. The diet of the Salmonidae studied is reported. Parasite infestation of Salmonidae is insignificant. The fish productivity of the rivers is 87-174 kg/ha.

5874. Konstantinova, N. A. 1961. SIGNIFICANCE OF THE FLOOD PERIOD IN THE SEASONAL DYNAMICS OF BIOLOGICAL ACTIVITY IN SOME FISH SPECIES OF THE LOWER VOLGA. (ZAACHENIE PAVODKOVOGO PERIODA V SEZONNOI DINAMIKE BIOLOGICHESKIKH POKAZATELEI NEKOTORYKH VIDOV RYB NIZHNEI VOLGI.) Trudy Soveshchanii Ikhtiol. Komissiya Akad. Nauk SSSR 13. 420-426; Referat. Zhur., Biol., 1962, No. 14I43; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4755. 1963.

The existing hydrological regime of the lower Volga is characterized by a pronounced alternation between the flood and normal periods. Specific adaptive relations to the sharp seasonal differences in conditions have been accumulated for each species. These include seasonal changes in biological activity (growth, condition factor) and in distribution: the ecology of spawning; the characteristics of feeding; and relative abundance. The biology of 5 species of fish is examined (bream, whitebream (Blicca bjoerkna), blue bream (Abramis ballerus), pike-perch, and pike), in which the character and duration of their relation to the flood-plain differ.

5875. Lukashov, V. N. 1961. DYNAMICS OF THE QUANTITY OF EXPLOITABLE SHOALS OF ROACH, BREAM, AND PIKE-PERCH. (DINAMIKA CHISLENNOSTI EKSPLUATIRUEMYKH STAD VOBLY, LESHCHA I SUDAKA SEVERNOGO KASPIYA.) Trudy Soveshchanii. Ikhtiol. Komissiya Akad. Nauk SSSR 13. 445-453; Referat. Zhur., Biol., No. 15I34; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4759. 1963.

In order to determine the degree of commercial exploitation of Caspian fish as compared with a possible optimum, an evaluation of the total supply was attempted. This was done by isolating periods of stabilization of the age groups of fish and hauls and establishing indices of fishing conditions in each period. Studies were based on data gathered over many years on the vobla (Rutilus), pike-perch (Stizostedion) and bream (Abramis). Assuming that the exploitation efficiency can be controlled by changes in the fishing procedure, it is concluded that optimum conditions could be approached by either reducing the size of the haul or by raising the age of the fish to be used commercially. The latter can be achieved by increasing the mesh size of the net. Raising the age of the fish by one year and simultaneously decreasing the number of fish caught improves the fishing efficiency for the above species three-fourfold.

5876. Ommanney, F. D. (Fish. Res. Unit, Univ. Hong Kong, Hong Kong, China). 1962. ORGANIZATION OF FISHERIES SCIENTIFIC RESEARCH.

Indo-Pacific Fish. Counc. Proc. 9(3): 22-29; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4766. 1963.

The problems of the fisheries research scientist in the survey of fish stocks, water masses affecting fishing grounds and plankton are discussed. The organization and equipment required to carry out such a program is dealt with in detail. The equipment of a research vessel, the shore base and personnel required are discussed. (Auth.)

5877. Smith, Bernard R. (P. O. Box 263, Marquette, Michigan), and Alberton L. McLain. 1962. ESTIMATION OF THE BROOK AND SEA LAMPREY AMMOCOETE POPULATIONS OF THREE STREAMS. Great Lakes Fish Comm. Tech. Rept. 4: 1-18; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4777. 1963.

Marking experiments on three streams in the Upper Peninsula of Michigan yielded quantitative estimates of populations of larval and transforming lampreys. The estimates not only gave an idea as to the numbers of ammocoetes in the streams, but also confirmed the judgments of abundance based on earlier surveys with electric-shocking equipment and provided valuable information on the movement of larvae during chemical treatment. The estimated numbers of ammocoetes in the three streams were 4, 300 in Furnace Creek, 30, 600 in Snyder Creek, and 336, 700 in the Ogontz River. (Authors)

5878. Suomela, A. J. (U. S. Fish and Wildl. Serv., Washington, D. C.). 1962. FEDERAL COMMERCIAL FISHERY ADMINISTRATION IN THE UNITED STATES. Indo-Pacific Fish. Counc. Proc. 9(3): 132-136; Biological Abstracts, Vol. 42, No. 2, Abst. No. 4780. 1963.

The origin, structure and function of the Bureau of Commercial Fisheries and the coordination of the work of the Bureau with other government agencies directly or indirectly concerned with one or more aspects of the fishery industry. The basis of good fishery administration is a sound national policy geared to the potential of the fishery resources and to the national interest. (Auth.)

5880. Dijkgraaf, S. (Univ. Utrecht, Utrecht, Netherlands). 1963. THE FUNCTIONING AND SIGNIFICANCE OF THE LATERAL-LINE ORGANS. Biol. Revs. 38(1): 51-105; Biological Abstracts, Vol. 42, No. 2, Abst. No. 5830. 1963.

Review of behavioral and electric physiological studies. Two groups of organs are distinguished: (1) The ordinary lateral-line organs (free neuromasts in all aquatic lower vertebrates, canal organs in most fishes, vesicles of Savi in Torpedo) are mechanoreceptors, stimulated by local water displacements, especially caused by moving animals ("distant touch"). The organs bear a cupula enclosing the sense hairs; minute lateral displacements in opposite directions cause opposite changes of the resting discharge frequency in the nerve fibers. Each sense organ has two kinds of receptors (hair-cells). The hair contains one long kinocilium and many short stereocilia; the kinocilium is arranged eccentrically on top of the cell, in one half of the cells at one side, in the remaining cells at the opposite side. Bending the hair towards the side of the kinocilium causes increase of discharge frequency, bending to the opposite side causes decrease. (2) The ampullary lateral-line organs (ampullae of Lorenzini in elasmobranchs, "mormyromasts" in mormyrids and gymnotids, "small pit-organs" in silurids, and other similar organs) are apparently electroreceptors, sensitive to weak local potential changes. They consist of a subcutaneous vesicle or ampulla containing the sensory epithelium and a duct connecting the ampulla to the outside. There is no cupula but the organ is filled with a jelly-like substance of relatively high electrical conductivity. More experimental evidence about functioning and significance of these sense organs is urgently needed. (Authors)

5881. Aleev, Yu. G. (Sevastopol' Biol. Sta., Sevastopol', USSR). 1962. THE LOCATION OF THE GREATEST BODY HEIGHT IN FISH. (O MESTOPOLOZHENII NAIBOL'SHEI VYSOTY TELA U RYB.) Zool. Zhur. 41(9): 1429-1431; Biological Abstracts, Vol. 42, No. 2, Abst. No. 6439. 1963.

In 153 species different in morphological and ecological characteristics, the greatest body height was found to shift caudad during both ontogeny and phylogeny. This is interpreted as an adaptation to rapid movement, since the flow remains laminar.

5882. Okun, P. A., et al. (Water Pollution Control Fed., Washington, D. C.). 1962. A REVIEW OF THE LITERATURE OF 1961 ON WASTEWATER AND WATER POLLUTION CONTROL. Jour. Water Pollution Control Fed. 34(7): 629-703; Biological Abstracts, Vol. 42, No. 2, Abst. No. 7058. 1963.

Part III of the Annual Review deals with Water Pollution. Topics covered include: Surveys and

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lic compounds, pulp and papermill wastes, pesticides, organic enrichment), Radioactive Wastes (physiological and pathological effects, apparatus and methods), Microbiology, Chemistry, Oxygen Sag and Stream Self-Purification, Water Pollution Surveys, Oceanography, Water Quality Standards, Abatement Progress, and Effects on Water Supply. 490 references are appended. (I. G.)

5883. Timofeev-Resovskii, N. V. 1960. THE DISTRIBUTION OF DISPERSED ELEMENTS AMONG THE COMPONENTS OF RESERVOIRS. I. SOME GENERAL CONSIDERATIONS. Inst. Biol., Ural Branch, Acad. Sci. USSR, Moscow. pp. 189-193; Biological Abstracts, Vol. 42, No. 1, Abst. No. 463. 1963.

In water bodies of various size studies were made of the action of radiation and radioactive agents on fresh-water organisms and certain fresh-water biocoenoses (e. g. periphyton); the coefficients of the accumulation of certain chemical elements from aqueous solutions by different soils and species of water organisms; the sorption and desorption of elements from water by soils and sludges; the distribution of dispersed and trace elements among the stagnant and living components of reservoirs; the degree of purification and deactivation of water passing through slow-running reservoirs. The author announces the impending publication of a series of articles on the biogecoenological study of reservoirs, dealing with the above-mentioned lines of research. Bibliography with 38 references.

5884. Uspenskaya, V. I., N. A. Levshina, and V. A. Ryabchenko. 1962. THE PLANKTON OF THE MOSCOW RIVER IN THE AREA OF THE ZVENGORODSK BIOLOGICAL STATION. (PLANKTON R. MOSKVY V RAIONE ZVENIGORODSKOI BIOSTANT SII.) Byull. Moskov. Obshchestva Ispytatelei Prirody Otdel Biol. 67(2): 34-44; Biological Abstracts, Vol. 42, No. 1, Abst. No. 464. 1963.

The studies of the development of plankton in the Moscow River (the Biological Station in the area of Zvenigorod) was carried out from 1956-1958 during the summer season almost daily under unstable weather conditions. It was established that throughout the summer months the phyto- and zooplankton of the river exhibited stability of its components and varied in regard to the changeability of the water's physical and chemical properties. The increase of the quantity of the suspended matter in water, especially during the spring floods, introduces a sharp change into the biocoenologic ratio of the plankton organisms. This period displays a decrease of the amount of the phyto- and zooplankton and an abrupt raise of the quantity of the microflora which is largely due to the increase of the total number of the bacteria organisms. The number of the latter increases owing to the turbidity of the detritus and the bacteria from the river floor and the dying

ay of the plankton. During the summer mid-level riod one observes quite a different picture with vorable conditions for the development of the phytoplankton, whereas the growth in bacteria is inhibited. The reduction of temperature reveals a definite influence upon the development of all the plankton organisms; the saprophytes are most sensitive to these changes. The investigation of the microflora in the river water showed that a most complete record of a reservoir requires data not only concerned with the saprophyte flora, but should also include the total number of bacteria examined by applying the direct method for counting. (Authors)

5885. Artimo, Atso (Dept. Zool., Univ. Helsinki, Helsinki, Finland). 1961. THE SPAWNING OF FISHES ON TREE BARK. (LAICHEN DER FISCHE AUF BAUMRINDENUNTERLAGE.) Arch. Soc. Zool. Bot. Fennicae "Vanamo" 16(2): 123-127; Biological Abstracts, Vol. 42, No. 1, Abst. No. 3940. 1963.

Experiments demonstrated that the pike-perch (Lucioperca sandra) spawns readily on spruce bark in water. The eggs develop and hatch normally in the bark nests. Hence, the assumed deleterious effects of the bark from floating timber on the spawning of fishes have probably been greatly exaggerated. (K. L.)

5886. Seppovaara, Ossi. 1962. ON THE SYSTEMATICS AND ECOLOGY OF THE SALMON AND TROUT IN THE INLAND WATERS OF FINLAND. (ZUR SYSTEMATIK UND OKOLOGIE DES LACHSES UND DER FORELLEN IN DEN BINNENGEWASSERN FINNLANDS.) Ann. Zool. Soc. Zool. Bot. Fennicae "Vanamo" 24(1): 1-86; Biological Abstracts, Vol. 42, No. 1, Abst. No. 3946. 1963.

The first part discusses particularly the salmon and sea trout found in the Iso-Saimaa, which is a typical relict lake, with many little islands. Many tables of measurements and comparisons are made. The occurrence of relict forms of salmon in other inland waters of Finland is also discussed. Comparisons are made between trout in streams and other fish of the trout group in Finland. The origin of t
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basin, differing from each other in a series of variable and distinct characteristics.

5888. Gomazkov, O. A., and B. V. Krayukhin (Inst. Biol. Water Reservoirs, USSR Acad. Sci., Borok, USSR). 1961. ROLE OF THE VAGUS IN REGULATING DIGESTION IN FISH. Fiziol. Zhur. SSSR 47(10): 54-58; Biological Abstracts, Vol. 42, No. 1, Abst. No. 939. 1963.

Division of the gastric branch of r. intestinalis n. vagi simistra changes considerably the nature of the digestive processes in burbot. It lengthens the time required for digestion, intensifies the secretion of gastric juice, changes the pH of the contents of the digestive tract, and disrupts the activity of the proteolytic enzymes. Our experimental data imply that in fish with stomachs the regulatory role of the vagus affects both the motor and secretory activity of the digestive tract. (Authors)

5889. Brett, J. R. (Fish. Res. Bd. of Canada, Nanaimo, B. C., Canada). 1962. THE RELATION BETWEEN OXYGEN UPTAKE AND SWIMMING SPEED IN YOUNG SOCKEYE SALMON. Amer. Zool. 2(3): 394; Biological Abstracts, Vol. 42, No. 1, Abst. No. 647. 1963.

The rate of oxygen uptake in Oncorhynchus nerka was determined for various swimming speeds, including fatigue levels, at temperatures of 5, 10, 15, 20 and 24° C. A logarithmic increase in oxygen demand for linear increase in swimming speed characterized each acclimation temperature. (Auth.)

5890. Miller, Robert Rush (Univ. Museums, Univ. of Michigan, Ann Arbor). 1963. DISTRIBUTION, VARIATION, AND ECOLOGY OF LEPIDOMEDA VITTATA, A RARE CYPRINID FISH ENDEMIC TO EASTERN ARIZONA. Copeia, 1963, No. 1, pp. 1-5.

5891. Perlmutter, Alfred, and William Antopol (Dept. of Biol., New York Univ., New York City). 1963. THE EFFECT OF NEOTETRAZOLIUM ON THE NEWLY FERTILIZED EGGS OF THE BROOK TROUT, SALVELINUS FONTINALIS (MITCHILL). Copeia, 1963, No. 1, pp. 166-168.

The ability of varying concentrations of NT to alter the metabolic rate of the fertilized trout egg with or without affecting survival, points to the possibility that other substances having similar effects may be responsible, at least in part, for the extent of survival of fish eggs and larvae in nature, and may be a determinant factor governing the size of the year classes. Such substances might be components of the metabolic wastes of other aquatic animals or plants or they may be present in the industrial effluents or metabolic wastes of man emptying into the earth's waters. (Authors)

5892. Rounsefell, George A. (Bur. Comm. Fish., Galveston, Texas). 1963. MARKING FISH AND INVERTEBRATES. U. S. Fish and Wildlife Service, Fishery Leaflet 549, 12 pp.

Reasons for marking fish and invertebrates are explained. The use and characteristics of various types of marks are discussed. The more successful tags in current use are illustrated, and the attributes of each explained, including methods of attachment and recovery, and how to select the most suitable mark for a specific species or experiment. (Auth.)

5893. Ricker, W. E. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. BIG EFFECTS FROM SMALL CAUSES: TWO EXAMPLES FROM FISH POPULATION DYNAMICS. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 257-264.

A population which, before exploitation, includes upwards of 12-15 age-groups in appreciable quantities, is very sensitive to fishing. For example, even as little as 5% catch per annum eventually causes a major reduction in the relative weight of older fish in the stock. With unchanging recruitment the absolute size of the total stock also declines markedly, or even catastrophically, under moderate exploitation--so much so that it seems likely that recruitment must usually increase when the stock is first thinned, partly compensating for the removals.

A population that produces its greatest sustained yield at a high rate of exploitation--say 75% or more at average recruitment--is then close to a point where recruitment will fall off rapidly if utilization becomes only slightly more intensive. This fact, and the aggravating effect of environmentally-caused variations in recruitment, suggests that any really close approach to the point of optimum yield will usually be too dangerous to be practical. (Auth.)

5894. Brett, J. R., and C. Groot (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. SOME ASPECTS OF OLFACTORY AND VISUAL RESPONSES IN PACIFIC SALMON. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 287-303.

Past and current research by the Fisheries Research Board of Canada related to olfactory and visual responses in Pacific salmon is reviewed, including comments on some of the sensory and behavioral relations important in migration.

An innate ability to perceive highly dilute odors supports the view that olfaction can be instrumental in detecting a distant source, but the problems of following a well directed course indicate likely support from other sensory paths including visual and acoustico-lateralis responses.

A threshold visual sensitivity of about 1/300 that of bright moonlight and an ability to orient at night, with view of the sky only, provide evidence that retinal images may be useful as migratory cues as long as turbidity does not interfere. (Authors)

5895. Keleher, J. J. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ont., Canada). 1963. THE MOVEMENT OF TAGGED GREAT SLAVE LAKE

FISH. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 319-326.

At Great Slave Lake, N. W. T., 3629 fish marked with Petersen tags were released during 5 years from 1946 to 1955. The time at large and movement of 505 recoveries, mostly lake whitefish, Coregonus clupeaformis, and lake trout, Cristivomer namaycush, are analyzed. Most of the tagged fish were caught in the summer commercial fishery; returns during the fall and winter were scarce. The median recapture time was 268 days; the maximum, for a lake trout, was 4027 days. Movement was generally limited; its median was 5 statute miles (8 km). A few fish traveled relatively long distances. There was no overall directional pattern to the movement, but some aggregation of the recaptured fish was noted. The fish populations are regarded as sedentary rather than mobile. (Auth.)

5896. Smith, M. W. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1963. INFLUENCE OF POND FORMATION ON BROOK TROUT MOVEMENTS AND ANGLING SUCCESS. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 327-345.

A 13-acre pond was formed at head of tide on Wilmot Stream, Prince Edward Island, to hold brook trout (Salvelinus fontinalis) moving between stream and saltwater estuary for greater availability to anglers. Trout continued to move between pond and estuary via an artificial outlet, predominantly during the spring and early summer. Improved angling conditions resulted in capture of 8,215 trout from pond and upper reaches of estuary at rate of 1.2 per rod-hour over three angling seasons. Shallowness of water limited trout-holding capacity of the pond and curtailed better angling success. Other hydrographic conditions and food supply in the pond were favorable for brook trout. (Auth.)

5897. Day, L. R. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1963. ORGANOGENESIS OF THE OPERCULAR APPARATUS IN SALVELINUS FONTINALIS (MITCHILL). Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 347-372.

The opercular fold in Salvelinus fontinalis (Mitchill) begins as a bulging, outward and backward, of the undifferentiated dorsally-packed mesenchymal tissue of the hyoid arch in embryos of 6.0-6.5 mm total length. From 6.5 to 9.0 mm, backward growth takes place although no gill arches are covered. The epithelium of the opercular anlage is 2- to 3-layered laterally and 1- to 2-layered with smaller nuclei medially. From 9.0 to 14.0 mm, i.e. hatching, the membranous lateral opercular and ventral branchiostegal portions extend posteriorly to cover the four gill arches. Ossification commences in the opercle, the jaws and the pectoral girdle. The epithelium which has scattered goblet cells is 3- to 4-layered antero-laterally, 1- to 2-layered postero-laterally and one cell in thickness medially. From 14.0 to 30.0 mm length ossification of the skeletal elements of the opercular apparatus takes place. The musculature of the operculum is complete at hatching. (Auth.)

5898. Saunders, Richard L. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1963. RESPIRATION OF THE ATLANTIC COD. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 373-386.

Measurements of routine and standard rates of oxygen consumption of various sized cod at temperatures between 3 and 15° C revealed a well-marked size effect; small cod consume oxygen at a greater rate per unit weight than do large ones. Increases in temperature raise oxygen consumption in starved and fed fish. The increase in rate of oxygen consumption of starved fish between 3 and 10° is proportionately greater than that between 10 and 15° C. Feeding of cod which have previously been starved increases the rate of oxygen consumption by 40-90%. The rate subsides to the starvation level in 4-7 days depending on temperature and amount of food eaten. Handling cod causes them to increase their rate of oxygen consumption; rates return to normal levels in 3-5 hours. Crowding reduces the rate of oxygen consumption apparently by reducing the space for movement and thus restricting activity. Reducing the ambient oxygen from about 10 to 3 mg/l lowers the rate of oxygen consumption slightly, but the respiratory volume (volume of water pumped over the gills per unit time) is markedly increased. This suggests there is added stress because the increased metabolic cost of irrigating the gills is not met by increased rates of oxygen consumption. (Auth.)

5899. Lawler, G. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1963. THE BIOLOGY AND TAXONOMY OF THE BURBOT, LOTA LOTA, IN HEMING LAKE, MANITOBA. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 417-433.

Vital statistics on the burbot, Lota lota, of Heming Lake, Manitoba, were collected over a period of several years. Age, weight and length data are presented. The maximum age of fish in the sample was 8 years. The largest fish (for which no age was determined) was 33 inches long and weighed 11 pounds. The growth of Heming Lake burbot appears slower than in Lakes Erie and Simcoe. The main types of food found in 1,441 burbot stomachs, in order of highest incidence, were yellow perch, ninespine sticklebacks and crayfish. Winter food was almost exclusively ninespine sticklebacks. The average number of eggs per female was approximately 1/2 million. Spawning probably occurred in early March.

The morphometry of the burbot of Heming Lake was described on a sample of over 100 fish. The inadequacy of most of the published data made comparisons with other populations almost impossible. It was concluded that, until statistically significant samples are obtained over the burbot's range, there is insufficient evidence for recognizing subspecific

differences and that all should be referred to as Lota lota (Linnaeus). (Auth.)

**5900.** McCauley, R. W. (Ontario Dept. of Lands and Forests, Fish and Wildl. Div., Southern Res. Sta., Maple, Ontario, Canada). 1963. LETHAL TEMPERATURES OF THE DEVELOPMENTAL STAGES OF THE SEA LAMPREY, PETROMYZON MARINUS L. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 483-490.

Of all stages of the sea lamprey, the eggs have the most exacting thermal requirements. The range of constant temperatures necessary for successful hatching is narrow, being 15-25° C. This range may be extended to 12-26° C and possibly beyond, if the eggs have developed to the head stage before they encounter temperature extremes.

The ability to withstand high temperature characteristic of the post-embryonic stages of the species appears shortly before or after hatching.

The role of temperature in the development of eggs under natural conditions is discussed. (Auth.)

**5901.** Lawrie, A. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1963. INTRASEASONAL GROWTH IN LAKE SUPERIOR LAKE TROUT. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 491-496.

Intraseasonal growth curves for lake trout, Cristivomer namaycush (Walbaum), of Lake Superior are deduced from a consideration of the increment in the number of circuli outside the last annulus of the scales as the season (1961) progressed. These curves are generally sigmoid and differ from one another in ways which suggest that they define differences in the onset, rate and duration of growth in the groups of fish concerned. However, the relationship between this measure of scale growth and the more conventional dimensional measures of both scale and fish growth have not been established. (Auth.)

**5902.** McCracken, F. D. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1963. SEASONAL MOVEMENTS OF THE WINTER FLOUNDER, PSEUDOPLEURONECTES AMERICANUS (WALBAUM), ON THE ATLANTIC COAST. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 551-586.

Winter flounders occur from Labrador to Georgia and yield large catches off southern New England. This paper related their distribution and seasonal movements to environmental factors.

In spring immature and mature flounders are alongshore with spawning fish concentrated in shallow water. During "summer", winter flounders leave the shore zone in areas where water temperatures rise above about 15° C but not where bottom temperatures do not reach this level. This movement toward cooler water does not continue into depths at which temperature is below about 12° C. Flounders return to the shore zone in fall after temperature decreases below 15° C. These temperatures are well above the upper incipient lethal for flounders of about 26° C.

Flounders remaining alongshore in summer are distributed in depth according to size and maturity. Small, immature fish are in the shallowest water, the region of highest light intensity, immatures of medium size deeper, and mature fish in both regions. Under experimental conditions immature fish of medium size moved into shade at lower light intensities than either small immatures or large matures.

North of Cape Cod flounders move deeper in "winter" as the shallow water becomes colder than the deeper. To the south spawning condition is reached earlier and mature flounders remain in shallow water during the cold-water period.

Off southern New England a large, sustained fishery denotes a large population of flounders. In the Bay of Fundy and off the coast of Nova Scotia winter flounders are restricted to a narrow depth zone, and good exploratory catches there probably do not indicate large populations. In the broader shallow zones of the southern Gulf of St. Lawrence similar catches suggest a larger population. Exploitation will depend on increased efforts by small otter trawlers or possibly development of marine sport fishing. (Auth.)

**5903.** Van Oosten, John (Bur. Comm. Fish., Ann Arbor, Michigan). 1963. SURFACE CURRENTS OF LAKE MICHIGAN, 1931 AND 1932. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 413, 51 pp.

Seven hundred forty-five bottles containing post cards for recording of information were released at stations in Lake Michigan; 283 were released June 17 to August 17, 1931, south of a line from Frankfort, Michigan, to Algoma, Wisconsin, and 462 during May 9 to August 25, 1932, both south and north of that line.

One hundred eighty-six bottles or 65.7 percent of those released in 1931, 331 bottles or 71.6 percent of 1932 releases, and 517 bottles or 69.4 percent of releases in the 2 years were recovered.

Recoveries of bottles from both years indicated that the surface currents were somewhat variable, but their general direction was from west to east and predominately northeast in 1931 and northeast and southeast in 1932. (Auth.)

**5904.** Paulik, G. J. (Coll. of Fish., Univ. of Washington, Seattle). 1963. ESTIMATES OF MORTALITY RATES FROM TAG RECOVERIES. Biometrics 19(1): 28-57.

Maximum likelihood and weighted regression estimators for determining the rate of survival and the rate of exploitation from tag recoveries are presented. Single release models for a continuous fishery with exact-time or interval-accuracy recovery data and the use of preseason releases to estimate losses are treated in detail. Discontinuities in the application of fishing effort, recruitment of tagged fish, and incomplete reporting of tags are also considered. (Auth.)

5905. Alderdice, D. F. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. SOME EFFECTS OF SIMULTANEOUS VARIATION IN SALINITY, TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF YOUNG COHO SALMON TO A TOXIC SUBSTANCE. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 2, pp. 525-550.

Median resistance times of juvenile coho salmon (Oncorhynchus kisutch) acclimated to fresh water at 12° C were investigated at 3 mg/l of sodium pentachlorophenate over combinations of levels of salinity, temperature and dissolved oxygen using factorial schemes developed by Box and associates. For the relationship:

$$\zeta = \varphi(x_1, x_2, x_3, \ldots, x_k)$$

a true response $\zeta$ is regarded as a function of combinations of levels of k quantitative factors $x_1$, $x_2$, $x_3$, ..., $x_k$. The relationship was approximated by a polynomial in x for the three coded factors--salinity ($x_1$), 0/00; temperature ($x_2$), °C; and dissolved oxygen ($x_3$), mg/l. The experimental data were fitted to a second-order polynomial:

$$Y = 59.9319 + 9.5469x_1 - 10.8943x_2 + 0.1746x_3 - 2.2690x_1^2 - 4.4291x_2^2 - 4.0143x_3^2 - 1.2360x_1x_2 + 2.5328x_1x_3 - 0.2671x_2x_3$$

This was transformed to its canonical form, from which ellipsoidal response surfaces were constructed. Alternative levels of salinity, temperature and dissolved oxygen were computed for general evaluation of the manner in which these variables altered the response to the pentachlorophenate. A maximum response time was computed for the response surfaces, associated with levels of the three variables at 17.68 0/00 salinity, 4.86°C and 7.66 mg/l, $O_2$.

The use of multivariable experimental techniques is discussed as a means of considering the significance of alteration in the levels of associated environmental factors in evaluation of experimental or environmental situations involving water quality alteration. (Auth.)

5906. Avdos'ev, V. S., I. F. Demchenko, I. M. Karpenko, and O. P. Kulakovskaya (Lvov Fish Husbandry Sta., USSR). 1962. THE TREATMENT AND PROPHYLAXIS OF PIKE INFESTED BY LEECHES. (LECHENIE I MERY PROFILAKTIKI PORAZHENIYA SHCHUK PIYAVKAMI.) Veterinariya 7. 60; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8768. 1963.

In view of the fact that the presently used agents (2.5% sodium chloride, 0.2% lysol, 0.2% freshly prepared unslaked lime and 0.0005% copper chloride) for the control of these leeches merely temporarily weaken but do not destroy them, the authors tried copper sulfate. They found that a freshly prepared solution of copper sulfate which had been clarified by the addition of a few drops of ammonia was highly effective in killing the leeches, when it was added to the surfaces of ponds in which the flow of water was stopped for 1-2 days. The optima leech-killing concentration of the copper sulfate was found to be 0.4-0.5 mg/liter. Since the leeches attack pike chiefly at the time of their transfer to wintering ponds, the procedure is very easy to carry out. (R. E. A.)

5907. Cooper, A. C., and K. A. Henry. 1962. THE HISTORY OF THE EARLY STUART SOCKEYE RUN. Prog. Rept. Internatl. Pacific Salmon Fish. Comm. 10. 1-48; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8780. 1963.

As far back as 1820 there are indications that the Early Stuart sockeye run to the Fraser River has never been large, and was subject to significant variations in abundance caused primarily by obstructions to its upriver migration in the Fraser Canyon. The construction of fishways at Hell's Gate, which had been an obstruction even prior to the Hell's Gate block in 1913, coupled with certain regulatory protection in the commercial fishery increased the average size of the Early Stuart run about seven times during the period 1949 to 1961. The increased size of the run and the occurrence of high river levels in recent years during the upriver migration of the Early Stuart sockeye have led to the discovery of several points that are still obstructions or present difficult passage. Recommendations are made for the removal of the remaining known obstructions, which are estimated to have already caused a loss of nearly one million dollars in the catch of sockeye, and which could cause further and more serious losses in the future under similar river flow conditions. (Authors)

5908. Dement'eva, T. F. 1961. THE DETERMINATION OF CATCH PER UNIT OF FISHING EFFORT FOR THE EVALUATION OF CHANGES IN STOCK DENSITY. (OPREDELENIE USILIYA NA EDINITSU LOVA DLYA OTSENKI IZMENENIYA PLOTNOSTI STADA.) Trudy Soveshchanii. Ikhtiol. Komissiya Akad. Nauk SSSR 13. 466-470; Referat. Zhur., Biol., 1962, No. 15I35; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8782. 1963.

The most important aspect of the present study of fish populations is the determination of mortality rate produced by industry and by natural causes. In this connection, the size of the fish population and its variation should be known first. These data are the bases for predictions of possible catches, and for formulating measures to regulate fishing. The evaluation of a fish population based on commercial fishing helps to determine the changes in the quantity of fish independently of the changes in fishing effort (amount and effectiveness of the fishing gear). The article analyzes types of commercial fishing, their advantages and disadvantages. It is assumed that the utilization of fishing time could be improved if trawling time were to be standardized.

5909. Fedii, S. P. (Inst. for Hydrobiol., State Univ., Dnepropetrovsk, USSR). 1962. THE EFFECT OF WETTING AGENTS, USED IN THE FLOTATION PROCESS FOR CONCENTRATION OF IRON ORE, ON THE ICHTHYOFAUNA IN BODIES OF WATER. (VLIYANIE REAGENTOV-SOBIRATELEI FLOTATSIONNOGO OBOGASHCHENIYA

ZHELEZNYKH RUD NA IKHTIOFAUNU VODOEMOV.) Rybnoe Khoz. 38(4): 29-32; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8784. 1963.

Sulfate soap (maximum concentration 500 mg/l) (I) and tall oil soap (maximum concentration 250 mg/l) (II) were added to aquaria with 40 l capacities. Studies were made of the $O_2$ content of the water immediately after addition of the wetting agent and one day later. It was found that both I and II caused a rapid decrease in the $O_2$ content, the effect of I being more marked. These agents had no effect upon the temperature of the water. Studies were also made on the effect of these wetting agents on the life-span of fish. The following species were employed: Gobius fluviatilis, Blicca bjoerkna, Perca fluviatilis, Leuciscus leuciscus, L. cephalus, and Chondrostoma. Water from the Dnepr River was used. It was found that increasing concentrations of the wetting agents decreased the life-span of the fish, apparently because of the sudden decrease in the $O_2$ concentration which they cause. (M. D.)

**5910.** Haslett, R. W. G. (West Ham Coll. Technol., London, England). 1962. MEASUREMENT OF THE DIMENSIONS OF FISH TO FACILITATE CALCULATIONS OF ECHO-STRENGTH IN ACOUSTIC FISH DETECTION. Jour. Concs. Perm. Internatl. Explor. Mer 27(3): 261-269; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8788. 1963.

Signal strength received on an echo-sounder was related to fish size and acoustic frequency. The acoustic properties of the various materials within a fish were also measured. The dimensions of average fish shape and structure (insofar as it affects the acoustic echo) is determined for whiting. Simplified approximations, based on this average, permit calculations of the contributions to the acoustic echo from different parts of the fish to be made more readily. Sticklebacks and guppies are suitable as scale models. If necessary, corrections could be made for deviations from this standard shape. (Auth.)

**5911.** Kulikova, E. F. 1961. ENVIRONMENTAL CONDITIONS FOR THE ICHTHYOFAUNA IN THE HUMUS WATERS OF SOUTHWESTERN KARELIA. (USLOVIYA OBITANIYA IKHTIOFAUNY V GUMIFITSIROVANNYKH VODOEMAKH YUGO-ZAPADNOI KARELII.) Uchenye Zap. Karel'sk. Pedagog. Inst. 11(2): 15-46; Referat. Zhur., Biol., 1962, No. 10I59; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8800. 1963.

Data are presented on the physicogeographical characteristics and hydrochemical properties of humus-type bodies of water. In rich waters higher aqueous plants develop slowly; they are usually limited to the most widely distributed eurybiontic species and to species with a narrow ecological spectrum. A dark brown water color, poor transparency, acid pH, high Fe content, and lack of biogenic elements (especially P compounds) all have a negative effect on the development of water plants. The fish in these waters consist mainly of thermophilic forms with a slow growth rate.

**5912.** Lewallen, Lawrence L., and William H. Wilder. 1962. TOXICITY OF CERTAIN ORGANOPHOSPHORUS AND CARBAMATE INSECTICIDES TO RAINBOW TROUT. Mosquito News 22(4): 369-372; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8805. 1963.

Laboratory tests with acetone solutions of 8 candidate insecticides for mountain Aedes control were conducted on one-week and one-month old hatchery reared rainbow trout fry, Salmo gairdnerii. Dosages approximating field application levels (in ppm) and 10 times field levels were applied in replicated tests. Of the materials tested, malathion was most toxic, followed closely by naled (Dibrom$^R$), DDVP, carbophenothion (Trithion$^R$), and parathion. No mortality occurred up to 72 hours after treatment with Dylox$^R$, Baytex$^R$, and Hercules AC5727. (Authors)

**5913.** Nikol'skii, G. V. 1961. SOME ASPECTS OF THE EFFECT OF FISHING ON THE STRUCTURE OF A POPULATION OF COMMERCIAL FISH AND THE CHARACTERISTICS OF THE INDIVIDUAL FISH. (O NEKOTORYKH ZAKONOMERNOSTYAKH VOZDEISTVIYA RYBOLOVSTVA NA STRUKTURU POPULYATSII I SVOISTVA OSOBEI OBLAVLIVAEMOGO STADA PROMYSLOVOI RYBY.) Trudy Soveshchanii. Ikhtiol. Komissiya Akad. Nauk SSSR 13. 21-33; Referat. Zhur., Biol., 1962, No. 15I26; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8814. 1963.

The effect of non-selective fishing on the composition of spawning fish was studied using mathematical models. If the spawners were caught indiscriminately and the age composition of the recruitment maintained unchanged, no "juvenation" (decrease in average age) of the stock occurred, even if the size of the stock was reduced considerably by fishing. The average age of the fish population increases if the recruitment is low. The juvenation of a spawning population caused by intensive fishing with constant recruitment, is ascribed to change in growth rate and age of maturity of the recruits. However, if the annual recruits number less than 50% of the total stock, the average age of the population increases in spite of the gradual decrease in age of recruits. If recruits exceed 50% of the total, the rate of reduction of the age composition of the population varies depending on the relative size of the recruitment. In the case of selective fishing, fish having certain properties are more intensively caught (certain sizes, sexes, maturities, thicknesses and fat contents). This is important for the planning of rational fishing. 30 references are given.

**5914.** Vashchenko, D. M. (Ukrain. Sci.-Res. Inst. Fish. Economy, Kiev, USSR). 1962. THE EFFECT OF PIKE ON THE CARP STOCK OF THE KREMENCHUG RESERVOIR. (VLIYANIE SHCHUKI NA ZAPASY SAZANA V KREMENCHUGSKOM VODOKHRANILISHCHE.) Zool. Zhur. 41(11): 1749-1751;

Biological Abstracts, Vol. 42, No. 3, Abst. No. 8835. 1963.

In Kremenchug Reservoir, at the sites of concentration of young carp, the pike is a dangerous predator which must be caught at the maximal degree. In other parts of the reservoir the pike is a beneficial predator which consumes fishes of little value and coarse fish. (Auth.)

5915. Lubitskaya, A. I., and E. A. Dorofeeva. 1961. EFFECT OF VISIBLE LIGHT, ULTRAVIOLET RAYS AND TEMPERATURES OF METAMERISM OF FISH BODIES. REPORT NO. 2. EFFECT OF ULTRAVIOLET RAYS ON SURVIVAL AND METAMERISM OF THE BODY IN ESOX LUCIUS L. AND ACERINA CERNUA L. (VLIYANIE VIDIMOGO SVETA, UL'TRAFIOLETOVYKH LUCHEI I TEMPERATURY NA METAMERIU TELA RYB. SOOBSHCH. 2. VLIYANIE UL'TRAFIOLETOVYKH LUCHEI NA VYZHIVANIE I METAMERIU TELA ESOX LUCIUS L. I ACERINA CERNUA L.) Zool. Zhur. 40(7): 1046-1057; Referat. Zhur., Biol., 1962, No. 17I14; Biological Abstracts, Vol. 42, No. 3, Abst. No. 8571. 1963.

Experiments were carried out on the embryos and larvae of Esox lucius L. and Acerina cernua L. After fertilization by dry method, the spawn were maintained during daylight in a spectrum without the red and infrared sections, and in darkness. This series had parallel results at different temperatures. Exposure to UV rays for one minute, was done at 2 different stages of growth. Brief exposure of the spawn to UV rays (588 ergs, 1 min. /1 $mm^2$) had a significant effect on the survival of the developing embryos and caused a decrease in the amount of metamerism. For the Esox lucius L., the caudal nodule stage was the most sensitive, and for the Acerina cernua L., the period of the swelling of the membrane.

5916. Monro, J. (School of Biol. Sci., Univ. of Sydney, Sydney, New South Wales, Australia). 1963. POPULATION CONTROL IN ANIMALS BY OVERLOADING RESOURCES WITH STERILE ANIMALS. Science, Vol. 140, No. 3566, pp. 496-497.

Sterile animals might be introduced into a population to overload a resource. As a result, some of the original fertile animals might be lost by migration or death. This process could be repeated until the fertile population was eradicated without the mating required by Knipling's models. This method may be of use in ecology and in economic control of populations. (Auth.)

5917. Chadwick, Harold K. (California Fish and Game, Sacramento). 1963. AN EVALUATION OF FIVE TAG TYPES USED IN A STRIPED BASS MORTALITY RATE AND MIGRATION STUDY. Calif. Fish and Game 49(2): 64-83.

All tags except spaghetti tags were tested by tagging groups of bass from the main population in the Sacramento-San Joaquin River System. All tags were also tested on bass held in a small pond, and a few tags were tested in an aquarium. Disk-dangler tags gave quite satisfactory results.

Substantial returns were received through the fourth year after tagging, but some were shed and they did affect angling vulnerability. They also caused some irritation and decreased growth. Hydrostatic tags gave similar results, but they probably caused less irritation. Dart tags were unsatisfactory because of a high shedding rate, and spaghetti tags were rejected because of excessive irritation. Streamer tags gave satisfactory returns for nine months, but returns indicate increased shedding after that. (Auth.)

5918. Brouillard, Keith D. (Bur. Comm. Fish., Ann Arbor, Michigan). 1963. ECONOMIC REVIEW OF THE GREAT LAKES COMMERCIAL FISHERIES, 1940-59. U. S. Fish and Wildlife Service, Circular 141, 20 pp.

Economic developments in the Great Lakes commercial fisheries since 1940 are examined, and catch, principal types of gear, marketing, and recent developments in the fishery are reviewed.

In a section on recommendations, the necessity for expanded research in fishing methods and marketing of the presently underutilized species is pointed out, consideration of fishermen's cooperatives is suggested, use of available species in new products is discussed, and cooperation among all research agencies is indicated to be a requirement if the fishing industry is to expand and strengthen its economic position. (Auth.)

5919. Abakumov, V. A. 1960. PROBLEMS OF THE FISHERY AND ARTIFICIAL REARING OF LAMPREYS IN CONNECTION WITH THEIR PARASITIC MODE OF LIFE. (VOPROSY PROMYSLA I ISKUSSTVENNOGO RAZVEDENIYA MINOG V SVYAZI S IKH PARAZITARNYM OBRAZOM ZHISNI.) Okhrana prirody i ozelenenie. Moscow 6. 21-23; Referat. Zhur., Biol., 1962, No. 16I106; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12856. 1963.

Because lampreys inflict serious damage on food fish, it is necessary that their commercial use be developed in every way and that the attempt to rear them artificially be ended which has been undertaken in the Estonian SSR. When catching Pacific and Arctic lampreys, their vigorous and brief spawning migrations must be taken into account. Considering the characteristics of northern and far-eastern rivers, it is necessary to use electrofishing based on their well-developed negative reaction to light.

5920. Barannikova, I. A. 1962. FUNCTIONAL BASES OF ADAPTATION IN ANADROMOUS FISH IN A CHANGE IN ENVIRONMENT. (FUNKTSIONAL'NYE OSNOVY ADAPTATSII ANADROMNYKH RYB PRI SMENE SREDY OBITANIYA.) Vysshaya Shkola: Moscow. 5: 10; Referat. Zhur., Biol., 1962, No. 17I65; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12845. 1963.

Study of the endocrine glands and vegetative core of the hypothalamus for the purposes of

clarification of the functional bases and mechanism of adaptation is discussed.

5921. Barsukov, V. V. 1961. RELATION OF FISH GROWTH RATES TO THE NUMBER OF INDIVIDUALS IN EACH YEAR-CLASS. (O ZAVISIMOSTI TEMPA ROSTA RYB OT CHISLA OSOBEI V POKOLENNYAKH.) Byul. Inst. Biol. Vodokhranilishch Akad. Nauk SSSR 11. 37-41; Referat. Zhur., Biol., 1962, No. 16I56; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12860. 1963.

In one of the lake varieties of catodromous whitefish in Lake Idshen (Sweden; G. Svärdson, 1953) and in pike-perch in the Rybin Reservoir, very fruitful generations in 1945 (whitefish) and 1946 (whitefish and pike-perch) were shown to have the slowest growth rate. In subsequent weaker year-clones the growth rate on the whole increased progressively after 1946. A preliminary explanation of this phenomenon is given, and the conditions under which it might be observed are enumerated. Cases are noted of the synchronization of variations in year-class strength in different species of fish and in different bodies of water. They are not causally inter-related.

5922. Belyanina, T. N. 1961. EFFECT OF THE SELECTIVE ACTION OF GILL NETS ON THE QUALITATIVE COMPOSITION OF THE FISH POPULATION ATTACKED. (VLIYANIE OTBIRAYUSHCHEGO DEISTVIYA OB'YACHEIVAYUSHCHIKH ORUDII LOVA NA KACHESTBENNYI SOSTAV OBLAVLIVAEMOI POPULYATSII RYBY.) Trudy Soveshchanii Ikhtiol. Komissiya Akad. Nauk SSSR 13. 254-259; Referat. Zhur., Biol., 1962, No. 14I20; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12861. 1963.

In order to investigate the selective action of gill nets, Fulton condition factors were compared between fish of the same length captured in the same place with gill nets and with seines or trawls. The fins so studied were Baltic sprat (Clupea sprattus balticus), Hemiculter leucisculus, ruff (Acerina cernua) and perch (Perca fluviatilis). Atlantic herring from drift nets of different meshes were also compared. When a gill-net mesh size is chosen so as to be optimal for catching the modal length group in the population, then the condition factor of the fish of modal size caught in seines or trawls is the same. Shorter specimens from the gill nets had larger condition factors than fish of the same length from trawl or seine, and vice versa. When gill-net mesh size is less than the optimum, the condition factor of fish of modal size, and the larger from the gill-net catches, was less than from a seine or trawl (in this case the mode of size composition of the gill-net catch is displaced to the left of the mode of the trawl catch). In small specimens from the gill-net catches condition factor was equal to or better than that of the same sized fish from trawl or seine catches. On increasing the mesh size of the gill-net, the fattest fish were selected from the small and medium sized fish in the population (in this case the mode of size composition of the gill net catch is displaced to the right of the mode of the trawl catch). The condition factor of the largest fish from the gill-nets was better than or equal to that of fish from the trawl or seine catches. It must not be considered that the optimal mesh is necessarily the best from the point of view of its effect on the fish population. For large-scale gill-net fisheries, a study must be made in each case of how a given assortment of nets affects the qualitative (size) composition of the population so as to avoid unfavorable results.

5923. Borutskii, E. V. 1961. THE FOOD SUPPLY AND PROVISION OF FISH WITH FOOD. (O KORMOVOI BAZE I OBESPECHENNOSTI RYB PISHCHEI.) Trudy Soveshchanii Ikhtiol. Komissiya Akad. Nauk SSSR 13. 67-77; Referat. Zhur., Biol., 1962, No. 14 129; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12864. 1963.

Four basic concepts have been distinguished in the problem of fish nutrition: (1) the food resources of the body of water--the combination of animal and plant organisms, of local and outside origin, and their decomposition products, whether or not they are used by fish; (2) the food supply for the fish of the body of water--the number of food organisms and their decomposition products which are in the body of water at a particular interval of time and which can be used as food by the fish species of the kinds and ages present under existing biotic and abiotic conditions; (3) the food consumed in the body of water--the part of the food supply actually consumed by the fish; (4) the food utilized by the fish--this involves not only the amount of food available for the population, but also the conditions for feeding and digestion of the food, including normal metabolism and growth of the fish. Between the food organisms and their utilization by the fish there exists complex adoptive interrelationships, of food organisms for protection from utilization by the fish, and of the fish for better utilization of the food supply. In order to increase the fish productivity of a body of water, the most complete transformation of food resources into usable food is necessary, as well as the creation of a fish fauna which is useful as food and which will utilize the food resources to the fullest extent. For this purpose, it is necessary to shorten the length of the food chain, and restrict the abundance of useless fish and predacious invertebrates.

5924. Bugai, K. S. 1962. PROPAGATION CONDITIONS FOR SEMI-MIGRATORY PHYTOPHILIC FISH DOWNSTREAM IN THE LOWER DNIEPER AFTER ITS REGULATION BY THE KAKHOV DAM. (USLOVIYA RAZMPNOZHENIYA POLUPROKHODNYKH FITOFIL'NYKH RYB V NIZOV'YAKH DNEPRA POSLE ZAREGULIROVANIYA EGO KAKHOVSKOI PLOTINOI.) Vysshaya Skkola: Moscow. 5: 17-19; Referat. Zhur., Biol., 1962, No. 17I76; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12865. 1963.

Construction of the Kakhov Dam reduced the spawning range of semi-migratory fishes. The normal passage of the parents into the river, spawning, and also the conditions for spawn incubation were

all disturbed. A number of measures are suggested for improvement of conditions for natural reproduction of fish in the lower Dnieper.

5925. Gorbunov, K. V. 1960. AEROBIC METHOD OF FERTILIZING PONDS FOR FISH BREEDING. (AEROBNYI SPOSOB UDOBRENIYA PRUDOV.) Rybnoe Khoz. Moscow. 200-201; Referat. Zhur., Biol., 1962, No. 17I94; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12872. 1963.

An aerobic method for the preparation of fertilizers was suggested and tested. Before application to the water the plant mass was treated in a mixture with manure for about 2 weeks in a special apparatus and was constantly sprayed with a fertilizing mineral mixture of saltpeter and superphosphate. The growth rate of zooplankton upon application of this method was 7 times greater than with the usual zonal fertilization.

5926. Greze, V. N. 1961. UNIFICATION OF FISH MANAGEMENT STUDIES OF RESERVOIRS. (OB UNIFIKATSII RYBOKHOZYAISTVENNYKH ISSLEDOVANII VODOKHRANILISHCH.) Akad. Nauk SSSR: Moscow-Leningrad. 109-113; Referat. Zhur., Biol., 1962, No. 17I73; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12873. 1963.

Examples were given of the inconsistency, incompleteness and incompatibility of the results of studies on various reservoirs, which indicates a need for cultivation of a single general plan for study and standardization of research methods. For comparison of results, it is necessary to establish a single period of research (beginning from the time the reservoir is created), and a minimum of problems for standardized research.

5927. Herbert, D. W. M. (Water Pollution Res. Lab., Stevenage, England). 1962. TOXICITY OF SEWAGE FOR FISH. (LA TOXICIDAD PARA LOS PECES DE UN EFLUENTE DE ALCANTARILLA.) Montes 18(106): 287-292; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12876. 1963.

The mortality of fish in sewage-polluted water was studied in relation to the physical and chemical condition of the water. The fish, mostly rainbow trout (Salmo gairdneri), were observed in floating cages in the river, below the mouth of a sewer, and in aquariums filled with the same water. Measured were temperature and pH of the water, dissolved O (percent of saturation), total and non-ionized N, free $CO_2$, and synthetic detergents. It was found that toxicity of the water was determined by a complex interaction of these factors. Trout, which are the most sensitive, did not occur naturally in the polluted water, but several other kinds of fish did, especially roach (bermejuela: Leuciscus rutilus) and perch (Perca fluviatilis), where the pollution was not too severe. (W. N. S.)

5928. Kaushik, D. K., and William T. Helm (Utah State Univ., Logan). 1961. OBSERVATIONS ON PITUITARY HORMONE INJECTIONS AND RIPENING OF FISH. Proc. Utah Acad. Sci., Arts, and Letters 39: 92-98; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12882. 1963.

Goldfish were used as experimental fish, and various experiments on pituitary injections were conducted. Male goldfish reached the full strippable stage within 12 to 18 hours after the injection of carp pituitary at 1.83 mg%. Female goldfish required higher doses than males and reached the full strippable stage within 12 to 18 hours after injection of carp pituitary at 4.16 mg% (2.3 times the male dosage). Carp pituitary injections in a series of small doses had much better effect on ripening of both male and female goldfish than the same amount in one massive dose. Female goldfish pituitary was more effective than male goldfish pituitary in eliciting a response from both male and female goldfish. Mature goldfish pituitary injected into goldfish was much more effective than immature goldfish pituitary. Intraperitoneal injection of carp pituitary was more effective than intramuscular injection of carp pituitary. Pituitary injection is probably more effective if the taxonomic relationship of the donor and the recipient is close. Pituitaries collected from a mature fish before their breeding season were more effective than from those which had recently spawned. (Authors)

5929. Krogius, F. V. 1961. RELATION BETWEEN GROWTH RATE AND ABUNDANCE OF SOCKEYE SALMON. (O SVYAZYAKH TEMPA ROSTA I CHISLENNOSTI KRASNOI.) Trudy Soveshchanii Ikhtiol. Komissiya Akad. Nauk SSSR 13. 132-146; Referat. Zhur., Biol., 1962, No. 14 I19; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12886. 1963.

The size and weight of downstream-migrative young sockeye is directly related to the abundance of plankton in lakes where they were nourished. The relationship between abundance of the young and their growth is variable and complex; in many lakes an inverse relationship is observed. Decrease in the numbers of parents directly and indirectly decreased reproduction. When the numbers of feeding young decreased their growth rate increased, there is more variation in length and weight, an increase in the length of stay in the lake, and sometimes an increase in the numbers of competing species. The average weight of downstream migrants is an index of the degree of utilization of the food resources: high values indicate insufficient utilization. Year-to-year sockeye is large, but less than in the downstream migrants. Among stocks of sockeye reproducing in lakes of southern Kamchatka, a trend in individual weight has been observed, that is opposite to the variation in numbers of western Kamchatka pink salmon, or of kokanee. The decisive stage in the maintenance of the numbers of sockeye is the reproduction in fresh water, and not the foraging in the sea.

5930. Saila, S. B., and R. A. Shappy (Narragansett Marine Lab., Univ. of Rhode Island, Kingston). 1962. MIGRATION BY COMPUTER. Discovery 23(6): 23-26; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12903. 1963.

A numerical probability model of salmon

migration was developed and a high-speed digital computer was programmed to simulate the migration of salmon. The purpose was to determine how precisely fish need to determine their course in order to have a good chance of finding the vicinity of the natal stream.

5931. Wager, Vincent A. 1962. AQUATIC LIFE JEOPARDIZED BY CHEMICAL SPRAYS. African Wild Life 16(2): 155-158; Biological Abstracts, Vol. 42, No. 4, Abst. No. 12913. 1963.

The author tested an organophosphate which is commonly used for mosquito control in order to determine its potency against other types of aquatic animals. The recommended spray when used as an insecticide is 1 part chemical to 500 parts water. The author used various concentrations--1 to 100, 1 to 1,000, 1 to 10,000, 1 to 100,000, 1 to a million, 1 to 10 million, and 1 to 100 million. The midge larvae and mosquito larvae all died in 1 in 10 million, the crabs and fish all died in 1 in a million and the tadpoles and snails died in 1 in 10,000 and 1 in 100,000. The organophosphate proved extremely lethal to fish and mosquito larvae and somewhat less so to tadpoles and snails. When spraying the surface of a pond it is difficult to gauge the quantity used or the resulting strength. On a calm day most of the spray would remain at the surface in concentrations strong enough to kill most animals which moved into it. The spray tested against mosquitoes is mixed at the rate of 1 part in 50 parts of water so that lethal doses would be apparent except perhaps on a windy day when thorough mixing would occur. (M. E.)

5932. Vaughn, L. R. (William Jewell College, Liberty, Missouri). 1962. THE INCIDENCE AND LOCATION OF METACERCARIAL CYSTS (NEASCUS SPP., "BLACK SPOT") ON SPECIES OF FISHES IN CLAY COUNTY, MISSOURI. Bios 33(4): 216-220; Biological Abstracts, Vol. 42, No. 4, Abst. No. 15760. 1963.

The spring incidence and location of metacercarial cysts (Trematoda: Strigeidae) on 223 Clay County, Missouri, fish representing 5 genera of the family Cyprinidae is presented. The fish genera, arranged in order of decreasing numbers of parasites, are: Notropis, Semotilus, Notemigonus, Pimephales, and Campostoma. The body proper exhibited the highest number of cysts with the caudal fin having more cysts than any of the other fins. (Auth.)

5933. Koo, Ted S. Y. (Coll. Fish., Univ. of Washington, Seattle). 1962. DIFFERENTIAL SCALE CHARACTERS AMONG SPECIES OF PACIFIC SALMON. Univ. Wash. Publ. Fish. 1: 123-135; Biological Abstracts, Vol. 42, No. 4, Abst. No. 15956. 1963.

Scale characters are used to differentiate the 5 spp. of Pacific salmon found in American waters. A synopsis of the characters is given for each spp. and for both parr and adult stages. Photographs of parr and adult scales of all 5 spp. are shown and a key to identification of spp. by scale characters is prepared. (Auth.)

5934. McCrimmon, H. R., and A. H. Berst (Ontario Agricultural Coll., Guelph, Canada). 1963. A PORTABLE A. C.-D. C. BACK-PACK FISH SHOCKER DESIGNED FOR OPERATION IN ONTARIO STREAMS. Prog. Fish-Cult. 25(3): 159-162.

A portable A. C.-D. C. back-pack fish shocker designed for use in Ontario trout streams is described. The basic unit, weighing approximately 15 lbs., consists of two 6-volt motorcycle batteries, a power converter, and 2 electrodes. A choice of alternating or direct current is available at the electrodes through the use of relays and silicon rectifiers. (Authors)

5935. Marlborough, David (Edgware, Middlesex, England. 1963. THE UNSUITABILITY OF MONEL METAL OPERCULAR STRAP TAGS FOR TAGGING CARP. Prog. Fish-Cult. 25(3): 155-158.

In a small eutrophic pond near London, 55 carp of various species were tagged with 3/8 inch clinched Monel metal opercular strap tags inserted in either operculum with clean, but not sterile, stainless steel surgical instruments in June and July 1961. Of 28 common carp (Cyprinus carpio) tagged, 3 were recaptured after 7 to 35 days at liberty; of 19 Crucian carp (Carassius carassius), 6 were recaptured after 10 to 39 days at liberty; and of 8 goldfish (Carassius auratus), none were recaptured. Of 6 recaptured fish finally considered, 4 showed adverse symptoms--inflammation, necrosis, and hematoma of the operculum, and secondary fungal infection. Three possible causes for these ill effects--mechanical abrasion, ion reaction, and bacterial infection--are discussed. (Auth.)

5636. Schwartz, Frank J. (Chesapeake Biol. Lab., Solomons, Maryland), and Paul F. Robinson. 1963. SURVIVAL OF EXPOSED OYSTER TOADFISH AND BIOLOGICAL CLOCKS. Prog. Fish-Cult. 25(3): 151-154.

The oxygen consumption of exposed toadfish (Opsanus tau) ranged from 0.014 to 0.025 ml/gm/hr. Total consumption was dependent on size. Survival ranged from 21 to 45 hrs. An unsuspected respiratory pattern discovered for this species showed activity and metabolism most active from 12 midnight to 6 a.m. The latter was suggestive of an inherent biological clock, perhaps dependent on tide. (Authors)

5937. Allison, Ray (Auburn Univ., Alabama), and H. D. Kelly. 1963. AN EPIZOOTIC OF ICHTHYOPHTHIRIUS MULTIFILIIS IN A RIVER FISH POPULATION. Prog. Fish-Cult. 25(3): 149-150.

Heavy parasitism with the protozoan ciliate (Ichthyophthirius multifiliis) caused extensive kills of gizzard shad (Dorosoma cepedianum) and threadfin shad (D. petenense) in the Coosa River system in Alabama in March and April 1962. Examination of dead and dying fish collected from approximately

200 miles of the river system revealed that the parasite had also affected other species--smallmouth buffalo (Ictiobus bubalus), channel catfish (Ictalurus punctatus), black bullhead (I. melas), blue catfish (I. furcatus), green sunfish (Lepomis cyanellus), crappie (Pomoxis annularis and P. nigromaculatus), largemouth bass (Micropterus salmoides), and fresh-water drum (Aplodinotus grunniens).

5938. Regier, Henry A. (Cornell Univ., Ithaca, New York). 1963. A COST ANALYSIS OF FARM PONDS IN TOMPKINS COUNTY, NEW YORK. Prog. Fish-Cult. 25(3): 144-148.

This analysis takes into account all costs of designing, constructing, and managing 0.2 to 1.5 acre Tompkins County ponds as such, and also costs of fish stocking and further management required for satisfactory fish production if the pond-owner chooses 1 of 4 recommended fish-stocking formulae--extensive trout (brook or rainbow), intensive trout, largemouth bass and golden shiners, and largemouth bass and bluegills. Costs are summarized as average annual equivalent costs; i.e., all costs are spread evenly over 20 equal annual payments with money earning 5% interest compounded annually. (Auth.)

5939. Uzmann, J. R. (U. S. Bur. Sport Fish & Wildl., Seattle, Washington), and J. W. Jesse. 1963. THE HEXAMITA (= OCTOMITUS) PROBLEM: A PRELIMINARY REPORT. Prog. Fish-Cult. 25(3): 141-143.

Chemical prophylaxis against Hexamita salmonis in a naturally infected hatchery population of juvenile coho salmon (Oncorhynchus kisutch) inhibited normal growth response. (Authors)

5940. Wolf, Kenneth W. (U. S. Bur. Sport Fish. & Wildl., Kearneysville, West Virginia). 1963. PHYSIOLOGICAL SALINES FOR FRESH-WATER TELEOSTS. Prog. Fish-Cult. 25(3): 135-140.

There are very few physiological solutions intended for fresh-water teleosts, and frog Ringer solution is commonly recommended for use with these fishes. More appropriate solutions have been developed by fish physiologists. Additional solutions have been found empirically by fish cell and tissue-culture workers, but the information is apparently not well known outside the specialized fields of interest. Using published data, a new saline for a fresh-water salmonid and probably other fresh-water teleosts was developed, tested, and compared with other physiological solutions. Like the serum constituents upon which they were based, the composition and freezing point of the older fish salines, and of the new fish saline in particular, showed remarkable similarity to two salines used for man. Frog Ringer solution proved distinctly different in composition and in freezing point, and its use with fresh-water teleosts is discouraged; instead, the new saline, a mammalian-type solution or appropriately supplemented or modified fish saline is recommended. (Auth.)

5941. Phillips, Arthur M., Jr. (U. S. Bur. Sport Fish. & Wildl., Cortland, New York). 1963. FOLIC ACID AS AN ANTI-ANEMIA FACTOR FOR BROOK TROUT. Prog. Fish-Cult. 25(3): 132-134.

It is concluded that folic acid is the factor "H" of trout nutrition, and a deficiency of this vitamin is the primary cause of anemia developed in trout fed meatless diets during previous studies. A concurrent vitamin $B_{12}$ deficiency increased the severity of anemia. (Auth.)

5942. Bregnballe, F. (Danish Trout Research Sta., Brøns, Denmark). 1963. TROUT CULTURE IN DENMARK. Prog. Fish-Cult. 25(3): 115-120.

Denmark is the world's largest exporter of pond-reared trout (16.9 million lbs. in 1962). Danish trout farmers have several advantages: (1) Fresh salt-water fish is fed to the trout in earthen ponds, making possible a high trout production per worker; and (2) The trout farms are concentrated in a small area (500 farms within 9,650 sq. miles), making the transportation of feed and trout cheap. A sketch of the pond arrangement is included, and the normal procedures in rearing trout are described briefly. The common trout diseases and control measures are listed, and the role played by the Danish Trout Research Station in the control of diseases is mentioned. (Auth.)

5943. Warren, James W. (U. S. Bur. Sport Fish. & Wildl., Cook, Washington). 1963. KIDNEY DISEASE OF SALMONID FISHES AND THE ANALYSIS OF HATCHERY WATERS. Prog. Fish-Cult. 25(3): 121-131.

Water analysis data and information on corynebacterial kidney disease were gathered from 40 National Fish Hatcheries which rear salmonids in this country. Recently workers in fish pathology have observed an apparent relation between the severity of fish kidney disease and the chemical constituent load of hatchery waters. A brief statistical analysis confirmed this general observation and further demonstrated that as the chemical constituent load of the water decreased, severity of kidney disease increased. The coefficient of correlation (r) and the regression coefficient (b) were calculated for 7 water constituents. Partial water analyses were reported for the stations surveyed, and some of the major factors affecting the incidence and severity of kidney disease were discussed. (Auth.)

5944. Barlow, John P., Carl J. Lorenzen, and Richard T. Myren (Dept. of Conservation, Cornell Univ., Ithaca, New York. 1963. EUTROPHICATION OF A TIDAL ESTUARY. Limnology and Oceanography, Vol. 8, No. 2, pp. 251-262.

The effect of heavy fertilization of the estuary of the Forge River on growth and photosynthesis of the phytoplankton has been studied over a 2-year period. Although there is distinct stratification in salinity, the nutrients added from the river are carried seaward by the circulation without significant tendency to accumulate in the deeper layer.

Nearly all the large amounts of organic matter accumulated in the estuary can be accounted for as being produced locally by the dense populations of plankton algae both from the relation between chlorophyll a and organic matter, and from consideration of the rate of oxidation of allocthonous organic matter in the estuary. The region provides a unique environment for the growth of phytoplankton which is shown in the photosynthesis: respiration ratios, and in the rates of photosynthesis per unit of chlorophyll, or assimilation numbers, that have been observed. (Authors)

5945. Antia, N. J., C. D. McAllister, T. R. Parsons, K. Stephens, and J. D. H. Strickland (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1963. FURTHER MEASUREMENTS OF PRIMARY PRODUCTION USING A LARGE-VOLUME PLASTIC SPHERE. Limnology and Oceanography, Vol. 8, No. 2, pp. 166-183.

The experiment described by McAllister, et al. (1961), in which a phytoplankton bloom was induced to occur in a free-floating 20-ft. diameter thin transparent plastic sphere has been repeated. Daily measurements were made of nutrients, particulate matter, and photosynthetic rates with less frequent assays for vitamins and dissolved organic matter. In situ light was recorded by a bolometer. The experiment was prolonged to 100 days to study phytoplankton decay, most of this period being in the dark.

The phytoplankton consisted mainly of 6 species of diatom and one large dinoflagellate. The mean composition of this crop at various stages of its development is reported by ratios involving chlorophyll a and particulate organic carbon.

A detailed discussion is given of the findings of the experiment which, in general, confirmed those of the earlier work and yielded, in addition, valuable new information.

The plant cells excreted 35-40% of their organic matter during growth. The $C_{14}$ method of measuring photosynthesis gave results agreeing well with the production of particulate carbon.

The growth kenetics of the bloom were dominated by the constancy of the mean cell division rates which were relatively independent of temperature and light. The rate of photosynthesis per unit chlorophyll was also remarkably constant and not proportional to light intensity, cells developing a highly efficient photosynthetic mechanism with respect to available radiant energy.

The mean chemical composition of a cell changed after depletion of nutrients from the surrounding water. The carbon, protein, chlorophyll a and phosphorus decreased. The silicon and lipid contents remained nearly constant and the carbohydrate increased.

During the decay period over half the particulate phosphorus was remineralized in 2 weeks. Silicon returned to solution more slowly but at a constant rate. There was no significant nitrification even after 75 days. The consumption of oxygen occurred mainly from the oxidation of "dissolved" organic matter and not from the interaction of oxygen with particulate material. The latter may have been important as a surface for bacteria. The evolution rate of carbon dioxide was constant with time but proceeded with a variable RQ, which was around 0.5 immediately after the bloom but increased to nearly 2 in the "old" water present at the beginning and end of the experiment. (Authors)

5946. Maciolek, John A. (U. S. Fish and Wildl. Service, Bishop, California). 1963. PRESSURE-FILTRATION APPARATUS. Limnology and Oceanography, Vol. 8, No. 2, pp. 301-302.

A simple, rugged unit is described. The apparatus, constructed from a few easily obtained materials, utilizes filter discs from 7/8 to 1 inch in diameter.

5947. Kahl, M. Philip, Jr. (Dept. of Zool., Univ. of Georgia, Athens). 1963. TECHNIQUE FOR SAMPLING POPULATION DENSITY OF SMALL SHALLOW-WATER FISH. Limnology and Oceanography, Vol. 8, No. 2, pp. 302-304.

A portable drop-trap which measures the fish population on an area and volume basis is described.

5948. Jefferts, K. B., P. K. Bergman, and H. F. Fiscus (Washington State Dept. of Fish., Seattle). 1963. A CODED WIRE IDENTIFICATION SYSTEM FOR MACRO-ORGANISMS. Nature, Vol. 198, No. 4879, pp. 460-462.

This article describes a system for identification of macro-organisms which has been applied to the Pacific salmon (Oncorhynchus sp.). As the title suggests, the information carrier utilized is a small segment of ferromagnetic wire, coded in one of several fashions. It is implanted in muscle or cartilage, and its presence is determined through the external effects of a permanent magnetic moment impressed on the wire segment. (Authors)

5949. Anonymous (U. S. Dept. of Health, Education, and Welfare, Div. of Water Supply and Pollution Control, Washington 25, D. C.). 1962. POLLUTION CAUSED FISH KILLS IN 1962. Public Health Service Publication No. 847, 21 pp.

This publication is the third annual report of fish kills caused by pollution occurring in the United States.

5950. Swan, M. A. 1963. SCALES WITH MALFORMED CENTERS. Salmon and Trout Magazine, No. 168, pp. 96-104.

It is still open to question whether malformed centers can occur in scales which have never been shed.

The great majority of malformed centers occurring in salmon, trout and char scales are regenerates following scale loss due to minor traumata.

Scale loss due to disease and regeneration after recovery does not seem to have been established and

is probably very rare.

Muller's finding that the ratio of normal scales to scales with malformed centers can be the same in all regions of the body appears to be the exception rather than the rule. In a trout and two char which had spawned, the percentage of scales with malformed centers was found to increase on passing from head towards tail, a state of affairs which may be a sequel of their spawning activities. (Auth.)

5951. Magnuson, John J., and Lloyd L. Smith, Jr. (Dept. of Ent., Fish. and Wildl., Univ. of Minnesota, St. Paul). 1963. SOME PHASES OF THE LIFE HISTORY OF THE TROUT-PERCH. Ecology, Vol. 44, No. 1, pp. 83-95.

The trout-perch of Lower Red Lake, Minnesota, were successfully aged from their scales, and growth history was back-calculated from scales of 1,684 fish subsampled from a total of 10,511 measured individuals. Relationship of anterior scale radius to body length was linear.

Group IV fish were the oldest taken, and males and females averaged 103.5 and 114.7 mm long at fourth annulus, respectively. Growth rate is reduced in both sexes after maturation. Instantaneous growth rate of young-of-the-year fish calculated from modes ranged from 0.020 to 0.024.

Growth compensation in trout-perch is apparently caused primarily by difference in growth rates of older fish rather than differences in hatching dates.

Annual fluctuations in growth varied as much as 14.4% of the mean annual increment for the period. First season's growth was strongly correlated with air degree-days ($r = +.84$). Second season's growth was also partially correlated with temperature ($r = +.80$) and correlated with first season's growth ($r = -0.90$ for males and $-0.79$ for females). Density of population had no demonstrable influence on growth.

Populations on the shoals in summer consisted of 31% Group I, 61% Group II, 8% Group III, and 1% Group IV fish. Age and sex composition varied widely in different years according to strength of year class. Group I males in the spawning population had a ratio to females of 13:1; Group II, 2.1:1; Group III, 0.18:1; and Group IV, 0:1. Relative strength of year classes ($\underline{P}$ rel) varied from 0.4 to 1.7 in 12 successive years.

Year-class strength was partially correlated with degree-days ($r = +0.83$) and partially with wind ($r = -0.62$). Size of reproductive capacity had no apparent influence.

Spawning runs start in May and end in August. Peaks of first spawning runs occurred after mean air temperature remained above 50° F for 44-46 days. There was a diurnal variation in spawning concentrations with the largest between 7:00 p.m. and midnight.

Relationship between length of ripe females and number of eggs was calculated. Reproductive capacity in various years varied more than fourfold. Adult walleyes were found to be the principal predators of trout-perch. (Authors)

5952. Wai, Evelyn Hui, and William S. Hoar (Dept. of Zool., Univ. of British Columbia, Vancouver, British Columbia, Canada). 1963. THE SECONDARY SEX CHARACTERS AND REPRODUCTIVE BEHAVIOR OF GONADECTOMIZED STICKLEBACKS TREATED WITH METHYL TESTOSTERONE. Canadian Journal of Zoology, Vol. 41, No. 4, pp. 611-628.

Treatment of intact juvenile or gonadectomized adult male and female sticklebacks with methyl testosterone, either by immersion in dilute solutions or by implantation of pellets into the body cavity, induces male secondary sex characters. The effect, as quantified by measurements of the height of the brush border tubules in the mesonephros, is the same in both sexes and reaches a maximum in 3 to 4 weeks. Both the gonadectomized males and females develop prespawning aggressive and territorial behavior if maintained 4 or 5 weeks under long-day photoperiods (16-hour day alternating with 8-hour darkness). Such behavior does not appear under a short photoperiod. The administration of methyl testosterone does not intensify aggressive behavior in either the 8-hour or 16-hour photoperiod fish. The combined effects of long photoperiods and methyl testosterone induces nest-building behavior (characteristic of normal breeding males) in 50% to 60% of the castrated males and about 6% of the gonadectomized females. The behavior of the treated males is qualitatively and quantitatively similar to naturally matured fish but that of the females shows differences. Although male sexual behavior may also be induced in androgen treated castrates, it has not been observed in the females under comparable experimental procedures. (Authors)

5953. Hoar, W. S., and J. G. Eales (Dept. of Zool., Univ. of British Columbia, Vancouver, British Columbia, Canada). 1963. THE THYROID GLAND AND LOW-TEMPERATURE RESISTANCE OF GOLDFISH. Canadian Journal of Zoology, Vol. 41, No. 4, pp. 653-669.

Although mammalian thyroid-stimulating hormone increases the low temperature resistance of goldfish, there is no evidence that the increased low-temperature resistance induced by either temperature acclimation or photoperiod control is operating by way of the thyroid gland. Likewise, no evidence was found for increased release of thyroid hormone during cold stress. Mammalian thyrotropin stimulates the secretion of thyroid hormone in goldfish as measured by radiochemical methods. Small doses produce a maximum elevation of plasma-bound radioiodine within 9 to 12 hours. A somewhat higher dosage of TSH seems to be required to stimulate the uptake of radioiodine by the thyroid. (Authors)

5954. Smith, Philip W. (Illinois Natural History Survey, Urbana). 1963. A STUDY OF SEASONAL DISTRIBUTION OF FISHES IN THE KASKASKIA RIVER DITCH, A HIGHLY MODIFIED STREAM IN EASTERN ILLINOIS. Copeia, 1963, No. 2, pp. 251-259.

Three sites on the Kaskaskia River headwaters in east-central Illinois, from which standardized seine hauls were made each month of the year, indicate that availability of fish and number of species represented vary with season and water level. Number of fish present is highest in winter, lowest in spring and early summer; number of species present is highest in late summer and fall, lowest in spring. Greatest seasonal fluctuation occurs in Pimephales notatus. Spring runs of catostomids and other migratory species do not now occur in the highly modified headwaters of this stream. (Auth.)

**5955.** Iwai, Tamotsu (Dept. of Fish., Kyoto Univ., Maizuru, Japan). 1963. TASTE BUDS ON THE GILL RAKERS AND GILL ARCHES OF THE SEA CATFISH, PLOTOSUS ANGUILLARIS (LACÉPÈDE). Copeia, 1963, No. 2, pp. 271-274.

Highly developed taste buds, by which the fish might taste food passing through the branchial cavity, are found in the epidermal layer of gill rakers and gill arches of the sea catfish, Plotosus anguillaris (Lacépède). The distributional pattern of the taste buds on the branchial apparatus of this species resembles that of fresh-water fishes. (Auth.)

**5956.** Eisler, Ronald (U. S. Fish and Wildl. Service, Sandy Hook Marine Laboratory, Highlands, New Jersey). 1963. PARTIAL ALBINISM AND AMBICORATION IN WINTER FLOUNDER, PSEUDOPLEURONECTES AMERICANUS. Copeia, 1963, No. 2, pp. 275-277.

Unusual pigmentation pattern of two juvenile Pseudopleuronectes is described and compared to similar patterns in other genera of heterosomids. Partial albinism is probably associated with injury to the fish. Causes of ambicoloration, or pigmentation of both ocular and blind side, may be phenotypic (exposure to light, brain damage) or genotypic. (Auth.)

**5957.** John, Kenneth R. (Franklin and Marshall Coll., Lancaster, Penna.). 1963. THE EFFECT OF TORRENTIAL RAINS ON THE REPRODUCTIVE CYCLE OF RHINICHTHYS OSCULUS IN THE CHIRICAHUA MOUNTAINS, ARIZONA. Copeia, 1963, No. 2, pp. 286-291.

The reproductive cycle of the speckled dace, Rhinichthys osculus (Girard), in the Chiricahua Mountains, Arizona, is bimodal, with discrete peaks in early spring and late summer, if the precipitation is normal. In periods of drought, overcrowded, undernourished populations fail to reproduce, and reproduction is otherwise thinly scattered in the spring and lacking in late summer. Rising temperature, increasing daylength, and perhaps flowing water are essential and adequate stimuli for spring reproduction but decreasing daylength, declining temperatures, and flowing water are inadequate stimuli for late-summer reproduction. Reproduction is greatest in the spring with streams swollen from melting snow, and in late summer following freshets or flash floods. A single flood in late summer induces spawning; a single flood in early summer does not. Basically, the reproductive period seems to be regulated by the photoperiod. (Auth.)

**5958.** Hewitt, Richard E., Lovie W. Word, Edna F. Haskins, and Caryl P. Haskins (Carnegie Inst. of Washington, Washington, D. C.). 1963. ELECTROPHORETIC ANALYSIS OF MUSCLE PROTEINS IN SEVERAL GROUPS OF POECILIID FISHES ESPECIALLY THE GENUS MOLLIENESIA. Copeia, 1963, No. 2, pp. 296-303.

The water-soluble fraction from whole muscle protein in twenty species of poeciliid fishes representing eight genera and four tribes of the Poeciliidae has been studied by paper electrophoresis. Special attention was paid to the genus Mollienesia, particularly to the morphologically polytypic species M. sphenops. In the electrophoretic work a Spinco Durrumtype electrophoretic cell was used, with a sodium potassium phosphate buffer. The procedure was derived from that described by Hamoir (1951, 1955), Connell (1953, 1954), and also of Block, Durrum, and Zweig (1958). It was found possible to obtain constant, marked, and reproducible differences between various tribes and genera. Moreover, species could be differentiated within a single genus, Mollienesia. Finally, within the single polytypic species M. sphenops geographically isolated populations could be distinguished. The implications of the method for investigations in the taxonomy of the Poeciliidae are discussed. More especially, the implications for the study of evolution among geographically isolated populations of a single species, as well as for the investigations of balanced biochemical polymorphism within single panmictic populations, are considered. Further work is in progress. (Authors)

**5959.** Liem, Karel F. (Zoological Lab., State Univ. of Leiden, Leiden, Netherlands). 1963. SEX REVERSAL AS A NATURAL PROCESS IN THE SYNBRANCHIFORM FISH MONOPTERUS ALBUS. Copeia, 1963, No. 2, pp. 303-312.

The reproductive cycle of the synbranchoid fish Monopterus albus was studied by histological observations of the gonads of 898 individuals of different ages and sizes raised in the laboratory and also of 96 individuals collected in the field. The younger and smaller individuals are exclusively functional females whereas the larger ones are functional males. Individuals of intermediate age and length possess ovotestes. The data show that in Monopterus every individual starts its reproductive cycle as a functional female and that males are produced only by sex reversal. A critical review of the different types of reproductive cycles in teleosts is given. It is suggested that the precarious poise of sexual identity in Monopterus may be a switch mechanism to maintain the full reproductive power of the population immediately after periods of critical conditions, and to prolong the reproductive capacity of many members of the population in fishes with sexual succession. (Auth.)

5960. Deubler, Earl E., Jr., and Gerald S. Posner (Univ. of North Carolina Inst. of Fish. Res., Morehead City, North Carolina). 1963. RESPONSE OF POSTLARVAL FLOUNDERS, PARALICHTHYS LETHOSTIGMA, TO WATER OF LOW OXYGEN CONCENTRATIONS. Copeia, 1963, No. 2, pp. 312-317.

Controlled laboratory experiments indicate that postlarvae of Paralichthys lethostigma exhibit non-random withdrawal from water of low oxygen concentrations when values fall below 3.7 ml/l.

Although flounder activity increases at higher temperatures (25.3° C), probit analysis indicates no differences in sensitivity to oxygen depletion at temperatures of 6.1° C, 14.4° C, and 25.3° C. (Authors)

5961. Savage, Thomas (Great Smoky Mountains National Park, Gatlinburg, Tennessee). 1963. REPRODUCTIVE BEHAVIOR OF THE MOTTLED SCULPIN, COTTUS BAIRDI GIRARD. Copeia, 1963, No. 2, pp. 317-325.

This paper reports the results of a laboratory study of the reproductive behavior of the mottled sculpin, Cottus bairdi, found in the streams of the Frederick, Maryland, area. The courtship and spawning behavior of fish kept in the laboratory was studied with primary emphasis on the behavior of the males.

A male at the entrance of the shelter responds to the appearance of a female with the manifestation of one of the three elements of cephalic display (shaking the head, nodding the head, and elevation of the gill-covers). Body undulations may be displayed initially in an encounter either singly or in company with one of the other elements. There was considerable variation in the behavior of the males with respect to: (1) the first display in an encounter, and (2) frequency of encounters in which a particular display was manifested. Nodding was consistently the least frequent of the three elements of the cephalic display during the encounters. Fanning was incorporated into the male's behavior during encounters with females, while solitary males in shelters containing eggs never fanned. There was as much variation in behavior between males with the same condition of the chin pore as between those of different pore condition; also, males spawned with females with either pore condition. (Auth.)

5962. Rivas, Louis Rene (Ichthyological Lab. and Museum, Dept. of Zool., Univ. of Miami, Florida). 1963. SUBGENERA AND SPECIES GROUPS IN THE POECILIID FISH GENUS GAMBUSIA POEY. Copeia, 1963, No. 2, pp. 331-347.

The status of the current subdivisions of the genus Gambusia is discussed and a reinterpretation of subgenera and species groups is proposed on the basis of new material. The analysis and reinterpretation of subdivisions is based exclusively on gonopodial characters. The various nominal species of Gambusia are discussed chronologically since the last revision and a list of the species provisionally accepted is given. The species Gambusia vittata Hubbs is shown to represent a new genus, Flexipenis, which is described under the authorship of Carl L. Hubbs. The subgenera Arthrophallus Hubbs and Heterophallina Hubbs are accepted as valid and Orthophallus is proposed as a new subgenus. The Gambusia nobilis and G. nicaraguensis species groups are reinterpreted, and the G. senilis, G. puncticulata, and G. punctata species groups are proposed as additional recognizable subdivisions of the subgenus Gambusia. Keys to the subgenera and species groups are given and gonopodia representative of the various subdivisions are illustrated. The geographical ranges of the subgenera and species groups are also figured. (Auth.)

5963. Wagner, Charles C., and Edwin L. Cooper (The Pennsylvania State Univ., Univ. Park). 1963. POPULATION DENSITY, GROWTH, AND FECUNDITY OF THE CREEK CHUBSUCKER, ERIMYZON OBLONGUS. Copeia, 1963, No. 2, pp. 350-357.

An estimate of the population of chubsuckers in a lake by a mark-and-recapture technique with trap nets indicated a sparse population of about 8 breeding adults per acre. Very few fish lived longer than five years; most fish older than four years were females. Egg production in the largest females (15 inches) averaged 29,000; for the population as a whole about 9,000 eggs were produced per adult fish. (Authors)

5964. Nishiyama, Tsuneo (Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan). 1962. EXTERNAL CHARACTERISTICS OF THE BRAIN OF "HIME-MASU", ONCORHYNCHUS NERKA VAR. NERKA (WALBAUM). Bulletin of the Faculty of Fisheries, Hokkaido University, Vol. 13, No. 3, pp. 117-122.

Observations were made on the external structure of the brain of hime-masu, a landlocked form of red salmon, Oncorhynchus nerka var. nerka (Walbaum).

In the olfactory lobe, the fissura endorhinalis remains as a vague furrow, and the sulcus ypsiliformis does not exist.

Both the shape and the coloration of the saccus vasculosus are highly variable according to the specimens. The coloration is considered to be closely associated with the amount of blood supply to this component.

The folding of the valvula cerebelli is composed of two pairs of hime-masu, while it is of three pairs in red salmon. (Auth.)

5965. Shirai, Kaoru (Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan). 1963. CORRELATION BETWEEN THE GROWTH OF THE OVIPOSITOR AND OVARIAN CONDITIONS IN THE BITTERLING, RHODEUS OCELLATUS. Bulletin of the Faculty of Fisheries, Hokkaido University, Vol. 13, No. 3, pp. 137-152.

Histological studies of the ovary in the bitterling, Rhodeus ocellatus, were undertaken for the purpose of clarifying the correlation between the

growth of the ovipositor and the ovarian conditions.

Ovarian conditions are described on the basis of oocyte maturity which progresses through ten stages.

The atretic oocytes are identical to the so-called pre-ovulation corpora lutea, morphologically speaking.

Under natural conditions, the process of maturation of ovaries is generally correlated to the fluctuations of the ovipositor length.

The fish cultured in high temperature exhibited regression of the oocytes. The same phenomenon was recognized in the fish of post-spawning season.

The absence of the fresh-water mussel exerts an influence which prevents maturation and ovulation of oocytes in the present experimental fish.

It would seem that the so-called pre-ovulation corpora lutea possesses no secretory function necessary for the growth of the ovipositor. (Auth.)

**5966.** Yoshioka, Hiroshi (Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan). 1962. ON THE EFFECTS OF ENVIRONMENTAL FACTORS UPON THE REPRODUCTION OF FISHES. I. THE EFFECTS OF DAY-LENGTH ON THE REPRODUCTION OF THE JAPANESE KILLIFISH, ORYZIAS LATIPES. Bulletin of the Faculty of Fisheries, Hokkaido University, Vol. 13, No. 3, pp. 123-136.

The fish maintained at room temperature and exposed to 18 hours of light per day, laid lighter and smaller eggs than the controlled group.

The fish kept at room temperature and exposed to artificial autumn daylight stopped laying eggs by July. Many regressive yolk-laden oocytes were found in their ovaries.

In out-of-normal spawning season, the fish kept at room temperature and exposed to long photoperiod succeeded in achieving maturation of eggs.

Under the same conditions as above, progressive testicular changes were found in the male exposed to long photoperiod and testes were matured enough to perform spawning acts. (Auth.)

**5967.** Ryland, J. S. (Fisheries Lab., Lowestoft, England). 1963. THE SWIMMING SPEEDS OF PLAICE LARVAE. The Journal of Experimental Biology, Vol. 40, No. 2, pp. 285-299.

Although there have been a number of studies on the swimming speeds of adult fish, there has been no work on their pelagic larvae apart from that of Bishai (1960). This clearly reflects the magnitude of the problems involved, for such larvae are difficult to obtain and so delicate that they are easily fatally damaged. Moreover, their transparency and small size add considerably to practical experimental difficulties.

However, hatchery technique developed in this laboratory facilitated the steady supply of suitable numbers of plaice (Pleuronectes platessa L.) larvae in excellent condition and at all stages of development. The plaice was a particularly desirable choice, because the larval biology of this species in the southern North Sea is receiving intensive study at the present time. One of the problems connected with such a survey of pelagic larvae is the development of an adequate sampling method, for it has been established that the larger fish larvae avoid capture by the commonly used Hensen and Heligoland nets (Ahlstrom, 1954; Bridger, 1956). Information regarding the swimming speed of larvae at different stages of development was therefore badly needed and was the object of the present investigation. (Auth.)

**5968.** Holmes, W. N., and R. L. McBean (Dept. of Zool., Univ. of British Columbia, Vancouver, Canada). 1963. STUDIES ON THE GLOMERULER FILTRATION RATE OF RAINBOW TROUT (SALMO GAIRDNERI). The Journal of Experimental Biology, Vol. 40, No. 2, pp. 335-341.

The rainbow trout (Salmo gairdneri) and its anadromous form, the steelhead trout, maintain their milieu interieur hypotonic to the environment after transfer to sea water (Houston, 1959, 1960). Such a transfer involves the physiological adjustment from a condition of continual hydration and electrolyte depletion to the opposite circumstance of a sustained tendency towards dehydration and excessive electrolyte intake.

Part of this physiological adjustment probably involves a reduction in urine flow of a magnitude comparable to the differences seen between stenohaline fresh-water and marine forms. Further, it has been suggested that such a reduction in urine flow may be achieved by a lowering of the glomerular filtration rate.

The purpose of this study was to examine the glomerular filtration rates of fresh-water-adapted and sea-water-adapted rainbow trout and also the effects of adrenocortical and posterior pituitary hormones on filtration in the fresh-water form. (Authors)

**5969.** Goldman, Charles R., David T. Mason, and Brian J. B. Wood (Dept. of Zool., Univ. of California, Davis). 1963. LIGHT INJURY AND INHIBITION IN ANTARCTIC FRESH-WATER PHYTOPLANKTON. Limnology and Oceanography, Vol. 8, No. 3, pp. 313-322.

Inhibition and injury of the photosynthetic mechanism resulting from high light intensities in the 24-hour Antarctic summer daylight were studied using $C^{14}$ in two small lakes on Cape Evans, Ross Island. The diel rates of carbon fixation were completely out of phase with light intensity, the effect being more pronounced at the surface than at depth. This inhibition could be quantitatively reduced by exposing the plankton to incident light passing a graded series of neutral density filters. A maximum rate was found at 20% of incident photosynthetic light at noon (0.10 langley/min), while photosynthetic efficiency in another experiment had decreased down to 0.06 langley/min close to the previous midnight. The effect of temperature increase upon the photosynthetic uptake in highly inhibited plankton was investigated, and a $Q_{10}$ of about 7 determined. Benthic and noninhibited

phytoplankton both had an average $Q_{10}$ of about 2. A brief sunlight exposure of plankton kept in dim artificial light brought about a reversible depression of photosynthetic rate.

The ecological importance of these results to phytoplankton production under the severe Antarctic conditions is discussed. (Authors)

5970. Gray, I. E., and M. J. Cerame-Vivas (Dept. of Zool. and the Marine Lab., Duke Univ., Durham, North Carolina). 1963. THE CIRCULATION OF SURFACE WATERS IN RALEIGH BAY, NORTH CAROLINA. Limnology and Oceanography, Vol. 8, No. 3, pp. 330-337.

Returns from helicopter-released drift bottles over Diamond Shoals, in April and August 1962, revealed a definite southwesterly coastal flow from Cape Hatteras, North Carolina.

Influenced by northeast winds the flow was more pronounced in late summer than in late spring, some of the bottles rounding Cape Lookout. Recovery of drift bottles from Onslow Bay and Bogue Sound strongly supports the theory that the temporary winter populations of distinctly northern species in the Beaufort, North Carolina, area become established from planktonic larvae that originated north of Cape Hatteras and were transported around the capes. A postulated circulation, involving the influences of Diamond and Lookout shoals, runoff, northeasterly and southwesterly winds, and back eddies from the Florida Current and from wind-induced currents, is presented for Raleigh Bay. (Authors)

5971. Yentsch, Charles S., and Carol A. Reichert (Woods Hole Oceanographic Inst., Woods Hole, Massachusetts). 1963. THE EFFECTS OF PROLONGED DARKNESS ON PHOTOSYNTHESIS, RESPIRATION, AND CHLOROPHYLL IN THE MARINE FLAGELLATE, DUNALIELLA EUCHLORA. Limnology and Oceanography, Vol. 8, No. 3, pp. 338-342.

After darkening Dunaliella cultures previously grown in continuous light, the capacity for oxygen evolution for one hour at light saturation increases as a function of time in darkness, reaching a maximum after 24 hours, and declining after 50 hours. Compensation occurs after 100 hours. This pattern was observed whether nitrate- or ammonia-nitrogen was used in the culture medium.

Oxygen evolution per unit chlorophyll reaches a maximum after 24 hours of darkness. Approximately 3.5 times more oxygen per unit chlorophyll is produced by cultures supplied with nitrate than by those supplied with ammonia.

After 40 hours of darkness cultures show no signs of adaptation of photosynthesis to lower intensities. Attempts to reestablish growth after 100 hours failed.

The importance of these results in connection with changes in the daily photosynthetic capacity of natural populations is discussed. (Authors)

5972. Regier, Henry A. (Dept. of Conservation, Cornell Univ., Ithaca, New York). 1963. ECOLOGY AND MANAGEMENT OF LARGEMOUTH BASS AND BLUEGILLS IN FARM PONDS IN NEW YORK. New York Fish and Game Journal, Vol. 10, No. 1, pp. 1-89.

To construct a factual and reasoned basis for a fish-stocking and management policy applicable to farm ponds in New York, various species and species combinations were studied. This paper concerns largemouth bass (Micropterus salmoides) and bluegills (Lepomis macrochirus) stocked according to three different formulae. Date on survival growth, reproduction, standing crops, harvests, and population condition were summarized and compared. Pond-owner preferences and practices, and pond costs, were determined.

It was concluded that a bass-bluegill combination might prove satisfactory in: (1) larger, deeper New York ponds whose surface temperatures rise above 80° F for several weeks each summer; (2) ponds where weeds can be controlled; (3) ponds whose owners have a genuine interest in fishing and managing the pond for bluegills as well as bass. A majority of farm ponds in New York likely do not meet these criteria. (Auth.)

5973. Hardy, C. J. (Fish. Lab., Wellington, New Zealand). 1962. AN EXAMINATION OF ELEVEN STRANDED REDDS OF BROWN TROUT (SALMO TRUTTA), EXCAVATED IN THE SELWYN RIVER DURING JULY AND AUGUST, 1960. New Zealand Journal of Science, Vol. 6, No. 1, pp. 107-119.

Eleven stranded redds of brown trout were excavated in the Selwyn River in July and August, 1960. Ova were collected from nine redds; two apparent redds were barren and were considered to be trial redds.

Counts were made of the number of egg pockets in each redd (3.7 average); the number of ova per pocket (468 average) and the total number of ova per redd (1,718 average). The approximate dimensions of the redd and the position of each egg pocket were noted. (Auth.)

5974. Mahringer, W. (Wien XIX., Hohe Warte 38, Germany). 1963. EINSCHICHTUNG UND VERTEILUNG DES ZUFLIESSENDEN WASSERS IM MILLSTÄTTERSEE. Archiv für Hydrobiologie, Vol. 59, No. 2, pp. 272-280.

Inserted stratification of turbid industrial waste water carried into the Millstätter-See by a small creek was investigated by means of a transparency meter. Depending on the seasonally variable thermal regime of the lake, the inflowing water spreads out in various water-layers in relation to their thermal stratification. Also the distribution of this contaminated water over the entire basin shows great seasonal changes being produced by variations of the overall velocity of currents in the lake as well as by variations of the thermal discontinuity layer. There sedimentation of suspended matter evidently is reduced. Following horizontal distribution of turbidity the general pattern of currents has been evaluated in this lake. (Auth.)

**5975.** Lehn, Hubert (Anstalt für Bodenseeforschung der Stadt Konstanz, Konstanz-Staad, Schiffstr. 56, Germany). 1963. EINIGE FRÜHJAHRSBEFUNDE ÜBER DIE ISOTHERMEN-PHYTOPLANKTON-RELATION IM BODENSEE. Archiv für Hydrobiologie, Vol. 59, No. 1, pp. 1-25.

In the spring of 1960 and 1961 the water temperature was measured by using an electric thermometer at depth steps of 1 m. each, down to a depth of 50 m. and secchi disc reading was performed as well, in a widespread net of research stations in the Überlingersee and the western part of the Obersee (Lake of Constance). Some samples of phytoplankton were drawn, the species of which were counted quantitatively by help of the Utermöhl inverted microscope.

In the spring, pelagic water masses of the Lake of Constance, particularly in its transversal axis, proved to be dependent on extraordinarily strong inclinations, torsions, convexities and depressions of isothermic water layers. These effects decreased as the lake surface became warmer. Stability of thermal stratification first develops in upper water regions, i. e. in the zones of photosynthesis. The distances from one isothermic level to another change frequently.

Phytoplankton follow these disarrangements of water bodies within the isotherms. In a transversal route (3, 4 km. in length) the lake density of phytoplankton might be at a depth of 50 m. on one side, ten times that of the other side at 0 m. After a quick swinging back of the isothermic water layers, however, the phytoplankton will again be uniformly distributed.

Especially in early spring, abnormal declinations of isothermic water masses, including their phytoplankton, often last a rather long time. Because of this, sedimentation, destruction and production of the organisms suffer variations to such an extent that the phytoplankton become distributed in a manner not explainable by the behavior of the isotherms.

Occurrence of phytoplankton can develop in coincidence with isothermic conditions as well as in contradiction at the same time on different districts of this lake. Even the species of algae differ in participating in these relationships.

The so-called "limnetic kinetics" represents an important factor of production by promoting one part of phytoplankton and checking the other at least in the spring. The first boom of plankton production early in the year may collapse by deep circulation of the water body being induced by strong wind. The more "eukinetic" a lake, the less representative single investigations are, on account of permanently varying conditions of water currents. (Auth.)

**5976.** Thomas, M. Pugh (Dept. of Zool., Univ. of Manchester, Lancashire, England). 1963. NOTES ON THE PRESENCE OF SIDA CRYSTALLINA IN THE PLANKTON AND THE ORIGIN OF THE FRESHWATER PLANKTON. Archiv für Hydrobiologie, Vol. 59, No. 1, pp. 103-109.

The occurrence of Sida crystallina in the open water of Llyn Tegid and Lac d'Eguzon is reported. The characters of specimens from these lakes are described and compared with those of S. crystallina s. str., and Sida limnetica in Lakes Geneva and Maggiore. The intermediate nature of the specimens from Llyn Tegid and Lac d'Eguzon is emphasized and it is suggested that in these two lakes the species is entering the open water from the littoral region. (Auth.)

**5977.** Yancey, Robert M., and Fredrik V. Thorsteinson (Bur. Comm. Fish., Auke Bay, Alaska). 1963. THE KING SALMON OF COOK INLET, ALASKA. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 440, 18 pp.

Runs of king salmon (Oncorhynchus tshawytscha) in Cook Inlet, Alaska, are declining. Paucity of information concerning the species led to an investigation in 1958 and 1959. Catch data show that the decline is real and not the result of restrictive regulations. The personal-use and sport fisheries are important factors affecting king salmon runs.

Age groups $4_2$, $5_2$, and $6_2$ occurred most frequently. Age group $6_2$ was dominant in 1958, $5_2$ in 1959. Shifts in the average size between 1958 and 1959 are associated with shifts in age-group dominance. A significant linear regression of the number of eggs on length was calculated.

Surveys to determine distribution, timing, and magnitude of the escapement proved impractical because of glacial melt, the vast area involved, and the great number of tributary streams used for spawning. (Authors)

**5978.** O'Connell, Charles P., and Roderick J. H. Leong (Bur. Comm. Fish. Biol. Lab., La Jolla, California). 1963. A TOWED PUMP AND SHIPBOARD FILTERING SYSTEM FOR SAMPLING SMALL ZOOPLANKTERS. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 452, 19 pp.

The construction, operation and performance of a towed pump and shipboard filtering system for sampling small zooplankters is described. The system is composed of (1) a collector containing a pump towed by a suspension unit consisting of a hose through which runs a steel cable for support and an electric line to power the pump, (2) a winch, and (3) a filtering unit composed of a watermeter, a double-throw valve and two filtering funnels. The towed collector and its electrically driven pump operate satisfactorily to a depth of 5 or 6 meters at a vessel speed of 9 knots. The winch is inadequate for the task it is meant to perform, but demonstrates that it is practical to use a winch with a hose and cable suspension. The filtering unit, easily operated by one man, is highly satisfactory. Discrete samples can be taken at intervals of a few minutes while traveling at vessel cruising speed by using the two funnels alternately. Special samples and tests indicate that errors due to escapement and entrapment of zooplankters and

to mixing of zooplankters between consecutive samples are negligible. It is concluded that the towed pump and shipboard filtering system is a practical sampling tool that needs further modification for the full utilization of its capabilities. (Authors)

5979. Day, C. Godfrey (Woods Hole Oceanographic Inst., Woods Hole, Massachusetts). 1963. OCEANOGRAPHIC OBSERVATIONS, 1960, EAST COAST OF THE UNITED STATES. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 406, 59 pp.

Daily water temperature and salinity observations for 1960 from eighteen locations along the Atlantic seaboard are tabulated, plotted and discussed for the fifth consecutive year. (Auth.)

5980. Warner, Kendall, and Owen C. Fenderson (Maine Dept. of Inland Fish. and Game, Ashland, Maine). 1963. THE SALMON AND TROUT FISHERY OF THE FISH RIVER LAKES, MAINE. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 193-201.

Partial creel censuses were operated on five of the Fish River Lakes in 1957-59 and on one of the lakes in 1954 and 1961 also. The salmon and brook trout fishing in general compared favorably with other large Maine lakes. Fishing success in Square Lake declined by 62 percent between 1954 and 1961. The decline is attributed to a reduced growth rate that delayed attainment of legal length. Salmon caught by anglers from all the lakes were primarily ages III-VI. Estimated yield to the angler ranged from 0.13 to 0.68 pound per acre. Brook trout were generally less abundant than salmon in the sport fishery. Trout were shorter lived than salmon and suffered a higher total mortality. The growth rates of salmon in the lakes are compared, and management possibilities are discussed for the different lakes. (Authors)

5981. Wagner, Harry H., Richard L. Wallace, and Homer J. Campbell (Oregon State Game Comm., Oregon State Univ., Corvallis). 1963. THE SEAWARD MIGRATION AND RETURN OF HATCHERY-REARED STEELHEAD TROUT, SALMO GAIRDNERI RICHARDSON, IN THE ALSEA RIVER, OREGON. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 202-210.

A program was initiated in 1956 to evaluate current hatchery practices and to determine ways of improving the rearing and liberation of juvenile steelhead trout. The physiological changes which result in the seaward migration of wild juvenile steelhead appear to occur most frequently when the fish are in the 14- to 18-centimeter length range. These fish may be 1 to 3 years of age, but the majority are 2 years old. Hatchery-reared steelhead exhibited the highest survival as returning adults when liberated at a length of 16 centimeters or longer. Results indicate that the optimum release date for hatchery-reared steelhead coincides with the peak movement downstream of wild steelhead smolts. (Authors)

5982. Jones, Bernard R., and John B. Moyle (Minnesota Dept. of Cons., St. Paul). 1963. POPULATIONS OF PLANKTON ANIMALS AND RESIDUAL CHLORINATED HYDROCARBONS IN SOILS OF SIX MINNESOTA PONDS TREATED FOR CONTROL OF MOSQUITO LARVAE. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 211-215.

Short-term effects of DDT upon summer populations of plankton animals in some Minnesota ponds are reported. DDT in bentonite and vermiculite granules was applied to three ponds in amounts used routinely for mosquito control: 1 pound per acre in early spring, and lesser amounts later as needed. By such application the nearly insoluble DDT is distributed in a thin layer on the pond bottom. Three similar ponds which were not treated with DDT during the 11-week study period served as controls. However, all six ponds had been treated with DDT in one or both of the two preceding years.

Averages of counts of cladocerans, copepods, ostracods, rotifers, and Volvox were of the same general magnitude for treated and control ponds. The crustacean counts from these ponds were similar to those reported from ponds in the St. Paul area investigated prior to the mosquito control program. A few days after treatment, however, there was indication of a depression of microcrustacean populations followed by apparent rapid recovery. Analyses of soils from the weedy margins of study ponds showed DDT concentrations ranging from 1.5 to 25.5 ppm. There were also small amounts of DDD and DDE in several of the soils. Heptachlor epoxide, which had not been used in the mosquito control program, was also found in soils from two of the ponds. (Authors)

5983. Cushing, Colbert E., Jr. (Dept. of Biology, Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada). FILTER-FEEDING INSECT DISTRIBUTION AND PLANKTONIC FOOD IN THE MONTREAL RIVER. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 216-219.

Bottom fauna and plankton populations at two physically similar locations on the Montreal River, Saskatchewan, were compared. Filter-feeding Trichoptera larvae were more abundant at the station below a series of productive lakes. This difference was related to the richer supply of suspended food in the water, rather than to differences in alkalinity. Ephemeroptera and Plecoptera distributions are also discussed. (Auth.)

5984. Smith, Lloyd L., Jr., and Robert H. Kramer (Dept. of Ent., Fish., and Wildl., University of Minnesota, St. Paul). 1963. SURVIVAL OF WALLEYE EGGS IN RELATION TO WOOD FIBERS AND SPHAEROTILUS NATANS IN THE RAINY RIVER, MINNESOTA. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 220-234.

Walleye (Stizostedion vitreum vitreum) eggs were incubated in a temporary jar hatchery using Rainy River water taken below paper mills discharging sulfite, kraft, insulating board, and

groundwood wastes. Eggs were also incubated in trays held on and off the bottom in the river below mills, above the mills, and in tributary streams. In two years, survival of eggs in jar controls was 31.2 to 73.5 percent. Survival to hatching of eggs jar-incubated in polluted water was 0.02 to 6.0 percent. At river stations below mills survival of tray eggs on bottom did not exceed 1.2 percent; and off bottom, 3.5 percent. Eggs held on bottom above mills had maximum survival of 37.6 percent; and off bottom, 49.1 percent. In most experiments in polluted Rainy River water the principal cause of mortality was Sphaerotilus growths on the eggs which prevented successful emergence of fry. Prior to hatching, egg-survival rate in jars was similar in controls and in experiments. Chemical treatment to remove slime increased hatch of eggs. Sphaerotilus-covered eggs removed to fresh water lost the bacterium and hatched at a high rate. Some bottom deposits below mills were toxic to eggs. (Authors)

5985. Lewis, William M., Robert C. Summerfelt, and Alvin Lopinot (Fish Research Lab. and Dept. of Zool., Southern Illinois Univ., Carbondale). 1963. RESULTS OF STOCKING CATCHABLE-SIZED WARM-WATER FISHES IN A LAKE WITH AN ESTABLISHED FISH POPULATION. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 235-238.

Three stockings of marked, catchable-sized, warm-water fishes were made in a 30-acre lake. Creel censuses were then conducted to determine the percent recapture of these fish and their contribution to the anglers' catches. The percent returns from the spring stockings during the year in which the fish were stocked were similar for the three principal kinds of fishes, namely: carppies, 32.0 percent; bullheads, 28.3 percent; and bluegill, 26.1 percent. Further returns from these stockings during the following year averaged only 2.5 percent. As compared to returns from the spring stockings, very poor returns resulted from a fall stocking subjected to fishing the following season. The overall return in this case was only 8.6 percent.

The contribution each kind of fish made to the anglers' catch of that fish varied with the density of the native population. Stocked crappies contributed 35.6 percent to the catch and bullheads 43.3 percent, while stocked bluegill contributed only 1.5 percent.

There was an unexpected increase in the catch of native fish in the year in which the stockings were made. The catch of native fish was 2,325 fish during the year prior to the stockings, 4,602 during the year of the stockings, and 2,835 during the year after. (Authors)

5986. Purkett, Charles A., Jr. (Missouri Cons. Comm., Jefferson City). 1963. THE PADDLEFISH FISHERY OF THE OSAGE RIVER AND THE LAKE OF THE OZARKS, MISSOURI. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 239-244.

In an unusually large fishery for paddlefish, Polyodon spathula (Walbaum), anglers took 8,210 to 4,920 paddlefish by snagging during the March 15-May 15 seasons of 1958-61 in the Osage River and Lake of the Ozarks, Missouri. Large fish caught averaged 33 pounds in 1958, and their average weight increased annually to 38 pounds in 1961. Most of those caught in 1959 were 11 to 21 years old, with some 27 to 30. Small fish began entering the harvest in 1959 and averaged 1.6 pounds that year, 3.5 pounds in 1960, and 4.3 pounds in 1961. These young fish were 2 to 4 years old in 1959. Total weight harvested varied from 70 to 107 tons annually.

The population of large paddlefish declined during the study period. Catch rates for large fish declined at least 37 percent, there was a high rate of recapture of tagged fish by anglers, and fish were lost over the floodgates of the dam which impounds the Lake of the Ozarks. Since it is desirable to maintain a population of large fish sufficient to provide angling until the small fish attain desirable size, restrictive measures were considered necessary. The possession limit was reduced from four fish to two (the same as the daily limit), the fall snagging season was eliminated, and the spring season was shortened by 15 days. (Auth.)

5987. Dahl, Jørgen (Danish Inst. for Fish. and Marine Research, Charlottenlund, Denmark). 1963. TRANSFORMATION OF IRON AND SULPHUR COMPOUNDS IN SOIL, AND ITS RELATION TO DANISH INLAND FISHERIES. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 260-264.

Oxidation of pyrite exposed in lignite strip mining or in draining of peat bogs results in sulphuric acid and ferric sulphate, which cause fish kills when washed into streams, lakes, or ponds. Increased lignite mining and land reclamation in Denmark since 1940 have resulted in much fish kill and loss of fish habitat. For example, the bottom of the river Tim å is covered with precipitated ochre, and the deposits even extend into the estuary. The fish population of Søby Lake was killed by water from an abandoned mine. Slaked lime added to discharge water from mines may prevent damage, but drainage from peat bogs and abandoned mines is more difficult to control. Of 126 areas in the Varde å river system used for liberation of trout fry in 1939, 31 percent were abandoned by 1961 because of acid water and ochre from land reclamation projects. (Auth.)

5988. Vibert, Richard (Directeur de la Station d'Hydrobiologie, Appliquée de Biarritz, France). 1963. NEUROPHYSIOLOGY OF ELECTRIC FISHING. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 265-275.

An explanation of the neurophysiological mechanisms leading to the galvanotaxy of fish with direct current electrofishing was developed by observing reactions of the fish to different potential gradients and by sectioning or otherwise interfering with the

nervous system at various points. With fish facing the positive electrode the first galvanotaxic response toward the positive pole (at 14 volts under the experimental conditions) is an inhibited swimming through effect on the long motor axons. Next (at 18 volts) there is intense, coordinated swimming resulting from intense negative charges on the sensory somas introducing a brain reflex, overcoming the inhibition of the motor axons. Third (at 40 volts) the fish becomes limp because the brain reflex cannot break through the increased inhibition of the motor somas. Fourth (90-100 volts) pseudoforced-swimming in which equilibrium is lost occurs through reflexes in the spinal nerves. Finally (at 150 volts) tetany is brought on by direct excitation of the muscle fibers. With fish facing the negative pole, the first galvanotaxic response (at 14 volts) is a tetanylike swimming toward the negative pole, due to facilitation of the central motor nerves, and only partially controlled by the brain. As the voltage increases, this brain control fails, and tetany appears through more excitation of (1) the motor somas in the brain, (2) the motor spinal nerves, and (3) the muscle fibers. When fish are placed across the electric field, the bodies curve toward the positive pole because the motor spinal nerves facing the negative pole are inhibited while those facing the positive pole are stimulated. Normal ecological behavior of the fish may significantly affect the response to electric current. Flatfishes, for example, may burrow or remain on the bottom resisting the swimming response until narcosis or tetany take over. (Auth.)

5989. Nilsson, Nils-Arvid (Drottningholm, Sweden). 1963. INTERACTION BETWEEN TROUT AND CHAR IN SCANDINAVIA. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 276-285.

Food habits of char (Salvelinus alpinus) and of brown trout (Salmo trutta) in lakes containing only one of these species are very similar. Both feed on Gammarus, Limnaea, Ephemeroptera nymphs, Trichoptera larvae, terrestrial insects, and small crustacea. When both species are in the same lake, trout feed primarily upon Trichoptera larvae and terrestrial insects, with char feeding on small crustacea. Gammarus and other bottom organisms are still eaten by both, but impounded waters have limited bottom fauna, and in these waters the segregation of char and trout is more pronounced. Trout are territorial and aggressive in comparison to the more pelagic char. In aquaria trout establish hierarchies with the dominant fish showing greater growth and survival. A diagrammatic model is presented to represent the food and habitat segregation observed. (Auth.)

5990. Lindroth, Arne (State Power Board, Stockholm, Sweden). 1963. SALMON CONSERVATION IN SWEDEN. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 286-291.

Hydroelectric power developments in Sweden are a menace to the populations of Atlantic salmon, Salmo salar L. Conservation measures, started as early as in the 1860's, now aim at the substituting of hatchery-reared 2-year-old smolt for the freshwater part of the life cycle of the salmon. The smolt plantings will soon reach 2 million annually, and the return now amounts to about 12 percent (100-125 pounds of salmon per 100 smolts), mainly taken as feeding fish in the sea. The artificial maintenance of the salmon populations is within reach. (Auth.)

5991. Yashouv, A. (Fish Culture Experimental Sta., Dor, Israel). 1963. INCREASING FISH PRODUCTION IN PONDS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 292-297.

Yields of carp (Cyprinus carpio) as high as 800-1,200 pounds per acre were secured when fish culture was initiated in Israel in 1938-39, but production has been increased three- to fourfold in recent years. Good, rich, water quality and annual growing seasons of 270 days permit such yields. Biweekly fertilization to provide 2 ppm nitrogen and 0.5 ppm phosphorus increased carrying capacity fourfold, and daily production almost tenfold. Fertilization does not increase plankton biomass or fish production proportionately, nor does it maintain plankton at a constant high level of abundance. Increased rates of fertilization do not increase primary production over a level controlled by density-dependent factors. Greater utilization of the productivity is secured by using carp and Tilapia nilotica, rather than just carp. Accumulation of metabolic wastes may be an important density-dependent factor controlling fish growth. (Auth.)

5992. Hofbauer, Josef. 1963. AUFSTIEG DER FISCHE IN DEN FISCHPÄSSEN DES MEHRFACH GESTAUTEN MAINES. Archiv für Fischereiwissenschaft, Vol. 13, No. 3, pp. 92-125.

Fishway controls for counting all fishes ascending in spring, should start before the water temperatures reach 7 to 8° C.

The older the river dam, the lesser the number of reophile fish ascending the fishway.

Favorable or unfavorable conditions of current below the fishway influence the total amount of fish ascending the river. Increased attracting current on either side of the fishway improves the ascending of the fish.

The influence of the water temperature on the migrations of fish differs greatly for the various species of fish. Generally speaking, a decreasing temperature diminishes the ascending, while an increasing temperature improves it.

Increasing water masses have a favorable effect; falling water, however, has an adverse effect.

Developing turbidness of water impairs the ascending of the fish, declining turbidness is again favorable. This is apparently vice versa for eel.

Maturity is the very impulse of the migrations, which are induced by the water temperature and influenced by fluctuations of the water level changes of turbidness and by light. When the interior

impulse is vanishing, the migrations cease without regard to the surrounding conditions. (Auth.)

5993. Mann, Hans. 1963. TRACHELIASTES MACULATUS (COPEPODA PARASITICA) AUF DEN SCHUPPEN VON ELBFISCHEN. Archiv für Fischereiwissenschaft, Vol. 13, No. 3, pp. 126-128.

In the course of the investigations into the existence of parasites on fishes of the river Elbe the Copepod Tracheliastes maculatus has been found on the scales of bream (Abramis brama). The parasite occurred most frequently in the dorsal area or near the peduncle of the fishes. The degree of the contamination greatly varied. A direct damaging effect by parasites could not be ascertained. (Auth.)

5994. Halsband, E., and P. F. Meyer-Waarden. 1963. ENTWICKLUNG EINES ELEKTROBIOLOGISCHEN TESTES ZUR BESTIMMUNG DER ABWASSERLAST VON FLÜSSEN. Archiv für Fischereiwissenschaft, Vol. 13, No. 3, pp. 139-141.

An apparatus has been designed in order to ascertain whether fishes living in an area where the perturbation in the gas exchange has reached the critical point, i. e. a medium where they could exist for a certain time but would leave that water, if there were any possibility for them to escape.

It has been observed that, in most cases, the experimental animals left the toxically changed medium after a certain time, swimming into the normal water. The time until the reaction occurred depended on the various substances added to the medium. It fluctuated between 2 and 180 minutes. (Authors)

5995. Brandt, A. V. 1963. DIE LEISTUNG VON NETZKONSERVIERUNGSVERFAHREN UNTER SUBTROPISCHEN UND TROPISCHEN BEDINGUNGEN. Archiv für Fischereiwissenschaft, Vol. 13, No. 3, pp. 141-154.

In countries with domestic cotton production, it may be more advantageous to use this fiber for making fishing nets than to use the man-made fibers. In this case, the nets must be protected from rotting by special methods. The net preserving methods developed in the West European fisheries were tested for suitability to high water temperatures, for instance in tropical areas. For that purpose cotton twines prepared by various methods have been tested at three tropical and subtropical stations and the results have been compared with similar tests made off Cuxhaven. It has been indicated that the decay of the cellulosis fibers occurs more rapidly in warm water, but that the net preparations most effective in West Europe also are most effective under tropical conditions and vice versa. (Auth.)

5996. Churchill, Warren S. (Wisconsin Cons. Dept., Madison). 1963. THE EFFECT OF FIN REMOVAL ON SURVIVAL, GROWTH, AND VULNERABILITY TO CAPTURE OF STOCKED WALLEYE FINGERLINGS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 298-300.

An experiment is described to evaluate the effect, if any, of fin removal on the growth and survival of walleye fingerlings, Stizostedion vitreum vitreum, stocked in a lake with a mixed fish population.

It was concluded that removal of one fin of 3-inch walleye fingerlings has no significant effect on their chance of survival or rate of growth when they are stocked in a lake with a mixed fish population including predators. Information derived from the stocking of fin-clipped walleye fingerlings may, therefore, be considered to be applicable to stocked unmarked walleyes.

5997. Swift, D. R. (Freshwater Biol. Asso., Windermere Lab., Ambleside, Westmoreland, England). 1963. INFLUENCE OF OXYGEN CONCENTRATION ON GROWTH OF BROWN TROUT, SALMO TRUTTA L. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 300-301.

Ten hatchery-reared brown trout less than 1 year old were kept in each of three aquaria maintained at 16° C and at 20, 10, and 15 mg/l of dissolved oxygen respectively, air saturation being 10 mg/l. The fish were fed to satiation daily with minced liver set in gelatin. At the beginning and end of the 5-week experiment, the fish were weighed and measured. The specific growth rates of the groups of fish in the three aquaria, expressed as percentage increases per week, were not significantly different.

5998. Blahm, Theodore H. (U. S. Bur. Comm. Fish., Fish-Passage Res. Program, Seattle, Washington). 1963. PASSAGE OF SALMON FINGERLINGS THROUGH SMALL TUNNELS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 302-303.

A series of tests was conducted to determine the optimum combination of water velocity and light condition that will most effectively facilitate downstream passage of salmon fingerlings through small tunnels.

Results of these tunnel tests indicated that the higher velocities 3.0 to 3.5 f. p. s., in combination with downstream light only, induced the highest percentage of downstream passage.

5999. Cushing, Colbert E., Jr., and P. A. Olson (Biol. Lab., Hanford Lab., General Electric Co., Richland, Washington). 1963. EFFECTS OF WEED BURNING ON STREAM CONDITIONS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 303-305.

Biological, physical, and chemical observations made before, during and after burning weeds sprayed with diesel oil are presented. The pH and the calcium and magnesium concentrations of the high-pH water were about twice those of the samples taken prior to burning. Potassium concentrations increased threefold, but sodium increased only slightly. Fish in live-boxes showed marked distress at the time of increased temperatures and high pH;

however, no mortalities resulted. In one experiment, fish held in cooled, neutralized water for 16 hours were affected, whereas those exposed to the cooled, non-neutralized water collected at the same time all died. This experiment emphasized the lethal effect of high pH to juvenile chinook salmon.

6000. Lander, Robert H. (Bur. Comm. Fish., Biol. Lab., Seattle, Washington). 1963. GIRTH-LENGTH RELATIONSHIPS IN SOCKEYE AND CHUM SALMON. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 305-307.

Girth-length relationships for sockeye and chum salmon (Oncorhynchus nerka and O. keta) ranging from 414 to 684 millimeters in fork length are presented. The hypothesis that a single line would describe girth-length relationships for both males and females was tested within each species and maturity group by analysis of covariance. The conclusion in all four tests was that a single line would suffice for both sexes. This conclusion cannot be extended to inshore waters, where pronounced sexual dimorphism occurs near spawning time.

In both sockeye and chum salmon, girth-length relationships of immature and maturing fish were found to differ.

6001. Boccardy, Joseph A., and Edwin L. Cooper (Bur. Sport Fish. and Wildl., Lamar, Pennsylvania). 1963. THE USE OF ROTENONE AND ELECTROFISHING IN SURVEYING SMALL STREAMS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 307-310.

Experiments indicated brook trout of different sizes (2-inch to 5-inch) were approximately equal in susceptibility to capture. However, electrofishing was consistently less efficient than rotenone in capturing fish of all size classes.

Since all size classes exhibited similar vulnerability to both capture methods, the total numbers of trout were used to compare recapture data among streams. This comparison indicated a considerable variation among streams in efficiency of capture.

6002. Priegel, Gordon R. (Wisconsin Cons. Dept., Oskosh). 1963. FOOD OF WALLEYE AND SAUGER IN LAKE WINNEBAGO, WISCONSIN. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 312-313.

During the winter of 1960, walleyes consumed more lake emerald shiners, Notropis atherinoides, than troutperch, Percopsis omiscomaycus, while saugers consumed equal amounts of each. The following winter, when troutperch and lake emerald shiners were scarce, the walleye and sauger demonstrated an increased utilization of chironomid larvae. During the fall of 1960, walleyes utilized yellow perch and brown bullheads which were completely lacking in the two winter samples. Only walleyes over 15 inches consumed drum.

6003. Ross, A. J., W. T. Yasutake, and G. R. White (U. S. Fish and Wildl. Serv., Western Fish Disease Lab., Seattle, Washington). 1963. HERMAPHRODITISM IN RAINBOW TROUT. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 313-315.

Notes are reported on a bisexual, hatchery-reared, rainbow trout (Salmo gairdneri), 11 inches fork length, and believed to be 3 years old.

It is concluded that as this rainbow trout contained only one testis, with no apparent vas deferens, it may be considered a true female exhibiting an apparently nonfunctional male feature.

6004. McCrimmon, Hugh H. (Dept. of Zool., Ontario Agric. Coll., Guelph, Ontario, Canada). 1963. THE RECOVERY OF TAGGED LAKE TROUT, SALVELINUS NAMAYCUSH, FROM LAKE SIMCOE, ONTARIO. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 315-317.

From 1953 to 1956 five hundred lake trout were tagged with plastic tags attached to the base of the dorsal fin by nylon thread. Recoveries between 1954 and 1963 totaled 76 trout or 15.2 percent of the number tagged. Growth data from the recaptured trout indicates that the Lake Simcoe fish grew much more rapidly during their early years of life than the trout from most waters.

6005. Renfro, William C. (Biol. Lab., U. S. Bur. Comm. Fish., Galveston, Texas). 1963. GAS-BUBBLE MORTALITY OF FISH IN GALVESTON BAY, TEXAS. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 320-322.

A natural mortality of fish due to gas-bubble "disease" is described.

6006. Wohlfarth, G., M. Lahman, and Rom Moav (Fish Culture Research Station, Dor, Israel). 1963. GENETIC IMPROVEMENT OF CARP. IV. LEATHER AND LINE CARP IN FISH PONDS OF ISRAEL. Bamidgeh, Vol. 15, No. 1, pp. 3-8.

The N allele, lethal in homozygous condition, and in heterozygous condition controlling the production of line carp and leather carp through epistatic interactions with the S locus, was found in several settlements in Israel.

Progeny tests showed that the growth rate of fish with the heterozygous genotype $N_n$ (line and leather) is poorer than that of fish with the homozygous $n_n$ genotype (mirror and scaly).

The influence of the N allele in lowering viability when in heterozygous condition was considerably smaller than that described by European workers.

In order to avoid the deleterious effects of the N allele, culling of the line and leather carp from the breeding stocks is recommended. (Authors)

6007. Radovich, John (California Dept. Fish and Game, Sacramento). 1963. EFFECT OF OCEAN TEMPERATURE ON THE SEAWARD MOVEMENTS OF STRIPED BASS, ROCCUS SAXATILIS, ON THE PACIFIC COAST. California Fish and Game 49(3): 191-206.

Comparisons of fisheries data and historical records with ocean temperature data indicate that cool water temperatures off San Francisco tend to keep striped bass from going to sea. During warm

years their distribution appears to shift seaward; behaving more nearly like they do on the Atlantic coast. (Auth.)

6008. Seeley, Charles M., Robert C. Tharratt, and Richard L. Johnson (Calif. Dept. Fish and Game, Sacramento). 1963. CALIFORNIA INLAND ANGLING SURVEYS FOR 1959 AND 1960. Calif. Fish and Game 49(3): 183-190.

Periodic angling surveys are conducted to assess statewide trends in angling success and pressure and to detect changes in major game fish populations. Since 1939, these surveys have been based on returns from postal card questionnaires.

Trout fishing continued to be the most popular form of angling. Over 50 percent of the anglers sampled had fished for trout. This fishery has remained rather stable for several years.

Increases in both angling effort and catch were noted for striped bass, black bass, catfish, and panfish. No major changes in angling quality were apparent except for an increase in the median annual catch per angler for black bass which rose from 5 in 1949 to 9 in 1959 and 1960. (Authors)

6009. Heimann, Richard F. G. (California Dept. Fish and Game, Terminal Island). 1963. TRAWLING IN THE MONTEREY BAY AREA, WITH SPECIAL REFERENCE TO CATCH COMPOSITION. Calif. Fish and Game 49(3): 152-173.

This report discusses the Monterey Bay trawl fishery and a sampling program designed to determine relative amounts of species caught, landed, and discarded. The fishery consists of three subfisheries: a shallow-water one in 40 to 60 fathoms taking chiefly English and petrale soles; an intermediate-depth one in 60 to 130 fathoms taking chiefly bocaccio and chilipeppers; and a deep-water one in 130 to 200 fathoms taking chiefly splitnose rockfish.

No sources of competition between the trawl and partyboat fisheries were revealed by this study. (Auth.)

6010. Abramson, Norman J. (California Dept. Fish and Game, Terminal Island). 1963. DISTRIBUTION OF CALIFORNIA ANGLING EFFORT IN 1961. Calif. Fish and Game 49(3): 174-182.

The distribution of 1961 fishing effort by California's licensed anglers in fresh waters, ocean waters, and waters of San Francisco Bay and the Sacramento-San Joaquin Delta was estimated from a postal card survey. Percentages of total angling days expended by licensed anglers in these waters, ordered as above, were 55.8, 29.4, and 14.8. Estimated percentages of licensed anglers who fished at least once in the different water types were 68.2, 47.0, and 20.3, while the percentages of licensees who fished only in a particular type of water were 31.1, 14.5, and 3.68, in the order mentioned above. An estimated 11.2 percent of licensees did not fish at all. Purchasers of about 124,000 3-day licenses good only in ocean waters were not included in the sampled population. The survey technique provided estimates corrected for nonresponse error but not for response error. Standard errors of the estimates were obtained.

6011. Geller, Irving (Wyeth Laboratories, Inc., Philadelphia 1, Pennsylvania). 1963. CONDITIONED "ANXIETY" AND PUNISHMENT EFFECTS ON OPERANT BEHAVIOR OF GOLDFISH (CARASSIUS AURATUS). Science, Vol. 141, No. 3578, pp. 351-353.

Hungry goldfish learned to press a lever for worms on a 2-minute variable-interval schedule of reinforcement. Lever pressing was suppressed in the presence of a flashing light by (1) pairing the light with a brief electric shock ("anxiety") and (2) punishing the lever-pressing behavior with electric shocks. (Auth.)

6012. Jolly, G. M. (Agricultural Research Council Unit of Statistics, Aberdeen, Scotland). 1963. ESTIMATES OF POPULATION PARAMETERS FROM MULTIPLE RECAPTURE DATA WITH BOTH DEATH AND DILUTION - DETERMINISTIC MODEL. Biometrika 50(1 and 2): 113-128.

Discusses the maximum likelihood equations of Leslie (Biometrika, 39: 363-388) with death and dilution operating simultaneously. General formulae are presented for variances and covariances of numbers and proportions of marked animals during various sampling times. A new family of estimation equations and finite population correction is presented.

6013. Daiber, Franklin C. (Dept. Biolog. Sciences, Univ. of Delaware, Newark). 1963. TIDAL CREEKS AND FISH EGGS. Estuarine Bulletin, Vol. 7, Nos. 2 and 3, pp. 6-14.

The great majority of the pelagic fish eggs and larvae are present during June and July. Most of them are found in tidal creeks in the lower half of the State of Delaware where the salinities are higher. This pelagic phase is not uniformly distributed at any one time: large numbers of eggs and larvae may enter one creek but not another. It appears as if little spawning occurs in the creeks. The greatest numbers of eggs and larvae enter the creeks on the flood tide that occurs after dark and primarily after the highest salinity is reached for that particular tidal cycle; they remain with this mass of water. Those floating larval-fish and eggs that are not eaten or stranded in the marsh amid grasses or on the mud, are out of the creeks by the time the salinity begins to decline. It is doubtful whether stranded eggs and larvae are able to survive until the next tidal change. Invariably there were far fewer eggs and larvae taken in the nets on the ebb tide than on the flood.

Since eggs and larvae are identified with the highest salinity water found in the individual creeks, it follows that they can be carried the full length of small tidal streams like Canary Creek, carried into the drainage ditches and sloughs, only to be swept from the creek on the ensuing ebb tide. In the larger creeks like the Broadkill they are carried upstream

only a short distance before their direction is reversed back down stream.

6014. Larkin, P. A. (Inst. of Fish., Univ. of British Columbia, Canada). 1963. INTERSPECIFIC COMPETITION AND EXPLOITATION. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 647-678.

The consequences of exploitation of either or both of a pair of competing species are examined using the Lotka-Volterra equations. The removal of a fixed proportion of a population on an instantaneous basis shifts the equilibrium population sizes for both the exploited species and its competitor. Similar shifts occur when both species are exploited. The maximum sustained yield of a species can be estimated under various degrees of exploitation of its competitor. The maximum combined sustained yield can be estimated for various relative values of the two species. From this analysis it is observed (1) harvesting only one species may provide a mistaken underestimate of capacity for sustained yield, (2) harvesting two species but relating yield to the fishing mortality rate of only one of the two may give a misleading overestimate of further capacity for sustained yield. Similar conclusions can be drawn if exploitation rate is proportional to abundance.

A stochastic version of the model is given for study of the effects of exploitation on small populations of competitors.

Fixed percentage exploitation and abundance proportional exploitation may be considered as depicting respectively the mode of action of density-independent and density-dependent factors. Accepting these parallels, the model may demonstrate some widely discussed properties of mechanisms of population regulation. Variability in factors both density dependent and density independent which are extrinsic to the biological system can be simulated in the model by random variates.

A discrete time model is described which was used with a computer for study of transitions from one steady state to another and extinction probabilities. The computer results confirm the theoretical predictions of the model. In addition it is suggested that there is no apparent difference in the result when competitors are exposed to the same or different random sequences of environmental effects of the same average intensity.

It is concluded that this formulation of interspecific competition together with variations should be applied to laboratory or natural situations to test its usefulness as a basis for prediction. (Auth.)

6015. Christie, W. J. (Ontario Dept. of Lands and Forests, Glenora Fish. Sta., Picton, Ontario, Canada). 1963. EFFECTS OF ARTIFICIAL PROPAGATION AND THE WEATHER ON RECRUITMENT IN THE LAKE ONTARIO WHITEFISH FISHERY. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 597-646.

No significant relationship could be found between variations in the level of fry planting and ensuing variations in the level of catch in the long-term statistics of the Lake Ontario whitefish gill-net fishery. An alternate-year planting experiment in which fry were planted in the even-numbered years 1944 through 1954, similarly failed to show a detectable level of contribution of the hatchery fish to the fishery. The supported year-classes averaged larger than those not given hatchery support but this was judged coincidental because of a phasing with an alternate-year periodicity which characterized the catch statistics over the whole series examined, and was present in the six years prior to the start of the alternate-year plantings. Estimates of spawning stock were calculated and it was not found that the progeny-per-parent ratios were significantly affected by the fry plantings.

A possible explanation for the periodicity was suggested by a significant correlation between air temperatures at the times of spawning and hatching, and the strengths of the produced year-classes. Cold Novembers followed by warm Aprils appeared to provide conditions associated with the production of larger year-classes, with the opposite combinations relating to the weaker broods.

The disappearance of lake trout and ciscoes from the commercial catch resulted in increased fishing pressure directed towards the capture of the whitefish. Increases in the efficiency and intensity of the fishing were observed during the period of the study and these were likely responsible for the reduction of the average age of the fish in the catch by almost one year, and the resultant restriction of the annual catch to one year-class in recent years. Probably because most of the fish are currently caught before first spawning, a decline in spawning stock was almost continuous during the study period. The year-to-year fluctuations in the level of the catch increased both because of the reduced average age, and because of a greater variation in year-class strength. The year-classes produced in favorable years tended to increase, down to quite low levels of stock. This gave a configuration similar to Ricker's Type C reproduction curve, and which differed chiefly in that the limiting diagonal representing minimum reproduction fell below the replacement diagonal. It was suggested that the whitefish may require more than one spawning, to achieve stock replacement. The present instability of the catch, and the potentially serious effect of any sustained break in the rhythm of the climatic conditions suggest a condition of over-exploitation in this case. (Auth.)

6016. McLaren, Ian A. (Fish. Res. Bd. of Canada, Arctic Univ, Montreal 18, Quebec, Canada). 1963. EFFECTS OF TEMPERATURE ON GROWTH OF ZOOPLANKTON, AND THE ADAPTIVE VALUE OF VERTICAL MIGRATION. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 685-727.

Existing theories of the adaptive value of vertical migration are examined and found wanting. Adult size and generation length are negative functions of temperature. It is shown that Bělehrádek's

temperature function gives a close fit to size and development rate of several species of zooplankters growing in adequate food supply, although conclusions do not depend on the theoretical content of this equation. Fecundity is an exponential function of adult size, and enough data are available for two quite different zooplankters - the copepod Pseudocalanus minutus and the chaetognath Sagitta elegans - to depict relative rates of increase as generally positive functions of temperature. Diurnal migrants are known to feed nearer the surface, which is almost universally warmer. Increased fecundity gained by spending part time in deeper, cooler waters, might be offset by slower development, although interrupted or seasonal breeders could sacrifice development rate for greater ultimate fecundity. However, an animal which does all necessary feeding in warm surface waters and "rests" in cooler waters gains an energy bonus which may be put into fecundity. A model of the effect on fecundity is derived from a much-generalized version of von Bertalanffy's growth equation. From the most probable range of solutions, it is deduced that migration in thermally stratified waters would be disadvantageous when surface waters were cool, but increasingly advantageous as surface waters warmed up, and this is supported by empirical evidence. The theory accounts for many geographical, seasonal, systematic and ontogenetic regularities in the large and confusing literature on vertical migration. (Auth.)

6017. Stewart, James E., P. L. Hoogland, H. C. Freeman, and A. E. J. Waddell (Fish. Res. Bd. of Canada, Technological Res. Lab., Halifax, Nova Scotia). 1963. AMINO ACID COMPOSITION OF REPRESENTATIVES OF EIGHT BACTERIAL GENERA WITH REFERENCE TO AQUATIC PRODUCTIVITY. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 729-734.

Representatives of eight bacterial genera were grown under identical conditions and the harvested, washed cells were analyzed quantitatively for eighteen amino acids using chemical methods. All of the bacteria contained the eighteen amino acids and, although quantitative differences were noted, variation in composition was not great. Cell nitrogen content averaged 11.91% of the dry weight. Some of the nutritional implications of the data are discussed. (Authors)

6018. Berst, A. H. (Dept. of Zool., Ontario Agri. Coll., Guelph, Ontario, Canada). 1963. THE SPATIAL DISTRIBUTION OF FISH IN GILL NETS. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 735-742.

The spatial distribution of yellow perch (Perca flavescens), white sucker (Catostomus commersoni), smelt (Osmerus mordax), chub spp. (Coregonus spp.) and alewife (Alosa pseudoharengus) caught in gill nets fished in South Bay of Lake Huron is described. The vertical distribution was essentially the same for all catches examined, the fish being concentrated towards the bottom of the net. The lateral distribution varied with species, mesh size and setting. Three types of lateral distribution were recognized, namely random, dispersed and bunched. Possible reasons for these different types and the relation between the distribution of fish in the net and in the water are discussed. (Authors)

6019. Hartman, G. F. (Fish and Game Branch, British Columbia Dept. of Recreation and Conservation, Vancouver, B. C., Canada). 1963. OBSERVATIONS ON BEHAVIOR OF JUVENILE BROWN TROUT IN A STREAM AQUARIUM DURING WINTER AND SPRING. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 769-787.

Observations were carried out in February-March and May-June periods during which water temperature ranges were 0.0-0.5° C and 8.5-12.5° C, respectively. Responses of fish to structures representing simplified environmental features, e. g. visual reference points, support against which fish could brace themselves in current, areas of slow water, overhead cover and areas of shade, were studied at three different water velocities. Winter and spring responses to illuminated and dark cover and to areas of rocky bottom were compared. Fish associated progressively more with experimental structures as more environmental features were incorporated into them. Degree of association with such structures and with other types of cover was much greater during winter. Degree of association increased with water velocity during both spring and winter. Increasing water velocities modified aggressive behavior. Fish displayed relatively more at low water velocities and nipped more at high velocities. It is possible that the association with and defence of specific locations on the bottom of a stream has selective value that alternates seasonally, providing the species with protection from predation and from displacement by current in winter, and with an efficient mode of food utilization in spring and summer. (Auth.)

6020. Premdas, F. H., and J. M. Anderson (Dept. of Biol., Carleton Univ., Ottawa, Ontario, Canada). 1963. THE UPTAKE AND DETOXIFICATION OF $C^{14}$-LABELLED DDT IN ATLANTIC SALMON, SALMO SALAR. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 827-837.

Atlantic salmon underyearlings were exposed to 1 ppm DDT-$C^{14}$ and the amounts of DDT adsorbed to external surfaces and absorbed internally determined separately on the basis of the $C^{14}$ activity. Fish killed by the exposure contained on the average 5.87 ppm DDT of which almost two-thirds represented absorbed DDT. After only 5 minutes exposure appreciable quantities of DDT were found throughout the body. At all times, up to and including the time of death, high concentrations of DDT were found in the gills, liver, spleen, heart, kidneys, gonads, and swim bladder. Much smaller concentrations occurred in the stomach, intestines, brain and spinal cord. The muscles, bone, and

integument contained the least. It was concluded that DDT entered mainly through the gills from whence it was transported throughout the body via the circulatory system.

Bioassays showed that on the average almost two-thirds of the absorbed DDT was nontoxic, or at least relatively so, to mosquito larvae. The adsorbed DDT showed little, if any, loss of toxicity. (Authors)

6021. Muir, Barry S., and Harold White (Univ. of Hawaii, Honolulu, Hawaii). 1963. APPLICATION OF THE PALOHEIMO LINEAR EQUATION FOR ESTIMATING MORTALITIES TO A SEASONAL FISHERY. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 839-840.

The following equation is derived to fit the case where fishing effort is concentrated into one season (say r = 1 month) but the natural mortality appears to be uniform throughout the year:

$$\log_e \frac{C_1/f_1}{C_2/f_2} = q \frac{f_1 + f_2}{2} r + M.$$

This is identical to Paloheimo's equation except for the term "r". Since r is some given fraction of the year (1/12 in this case), then a seasonal fishery would give the same solution as a year-round fishery with the same total effort. For the seasonal fishery, the daily effort values are 12 times those of the year-round fishery but they are in operation for only 1/12 (r) of the year.

Thus, the serious restriction, of year-round fishing, apparently inherent in the Beverton and Holt formula, is removed in Paloheimo's approximation. Provided all other conditions are met, catch-per-unit-effort data from seasonal fisheries may be used for the estimation of natural and fishing mortalities.

6022. Hochachka, Peter W. (Dept. of Zool., Univ. of Alberta, Edmonton, Alberta, Canada). 1963. ON THE NEED FOR MEASURING THE BUFFERING CAPACITY OF FISH BLOOD. Journal of the Fisheries Research Board of Canada, Vol. 20, No. 3, pp. 845-847.

Experiments indicate that for a given hemoglobin determination to have any particular relevance, at least five factors - age, diet, physical training, exercise per se, and oxygen tension - must be defined or in some way be under control. It is concluded that a hemoglobin index of buffering capacity is impractical for most purposes.

6023. Lissmann, H. W., and K. E. Machin (Dept. of Zool., Univ. of Cambridge, Cambridge, England). 1963. ELECTRIC RECEPTORS IN A NON-ELECTRIC FISH (CLARIAS). Nature, Vol. 199, No. 4888, pp. 88-89.

It is now well established that certain fish have weak electric organs and can detect objects electrically. A series of experiments utilizing a Gymnarchus niloticus confirmed the hypothesis that the incoming electrical signals were "smoothed" at the electric receptors before being coded into impulses in the afferent nerves. It was further found that the fish was unexpectedly sensitive to trains of pulses of low-repetition frequency. This suggested that adaptation of the receptors was taking place with a time constant of some tens of milliseconds. Each successive pulse of the train would then give rise to a separate sensory signal. The purpose of this remarkable sensitivity is still unknown.

6024. Bonn, Edward W. (Texas Game and Fish Comm., Denison). 1962. FISHERMEN'S USE OF MUNICIPAL RESERVOIRS IN TEXAS. Proc. Texas Water Sewage Works Short Sch. 44: 139-140; Biological Abstracts, Vol. 42, No. 5, Abst. No. 16054. 1963.

Greater future increase of fishermen than of reservoirs is expected. (G. E.)

6025. Eales, J. G. (Dept. of Zool., Univ. of British Columbia, Vancouver, British Columbia, Canada). 1963. A COMPARATIVE STUDY OF THYROID FUNCTION IN MIGRANT JUVENILE SALMON. Canadian Journal of Zoology, Vol. 41, No. 5, pp. 811-824.

Seasonal thyroid change was assessed by histological (mean lowest epithelial height) and radiochemical (conversion ratio) techniques in four species of juvenile anadromous Pacific salmon in fresh water. Both sockeye and coho, migrating predominantly in their second or third spring, had, at migration, relatively much higher thyroid activities, which declined rapidly in postmigrants held in fresh water. Pink and chum, obligatory fry migrants, had moderate cell heights at migration. Migrant chum were too small for radioiodine examination but migrant pink showed very slow $I^{131}$ turnover. Prolonged retention of pink and chum salmon in fresh-water brought about a general decline in cell height, despite very high conversion ratios. It is concluded that, at migration, fry migrants (pink and chum) have relatively inactive thyroids while yearling migrants (sockeye and coho) have active thyroids. (Auth.)

6026. Craigie, David E. (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1963. AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII RICHARDSON. Canadian Journal of Zoology, Vol. 41, No. 5, pp. 825-830.

Two groups of Salmo gairdnerii were reared from fertilization in hard and soft waters, and the thermal resistance of the yearling trout was measured for both groups in soft and saline waters at 27, 28, and 29° C. In all cases a history of rearing in soft water resulted in a greater resistance to thermal stress than did a history of rearing in hard water. Increased salinity of the testing medium resulted in an increase in thermal resistance. (Auth.)

6027. Nursall, J. R. (Dept. of Zool., Univ. of Alberta, Edmonton, Alberta, Canada). 1963.

THE CAUDAL MUSCULATURE OF HOPLOPAGRUS GUNTHERI GILL (PERCIFORMES: LUTJANIDAE). Canadian Journal of Zoology, Vol. 41, No. 5, pp. 865-880.

The caudal musculature of Hoplopagrus comprises dorsal and ventral superficial flexors reinforced by a deltoid flexor tendon, dorsal and ventral deep flexors a hypochordal longitudinal muscle, a dorsal adductor, and interradials. These provide for flexion, extension, abduction, adduction, rotation, and probably circumduction of fin rays. The muscles are innervated by a spinal nerve plexus. The fin rays articulate with the caudal vertebral skeleton by a well-developed joint capsule with a synovial space. Dissection of a series embracing Palaeoniscoidei-Holostei-Teleostei suggests how there has been an evolution of specialized effectors to actuate a caudal fin of increasingly complex function. A table of synonyms of muscles of the caudal fin is included. (Auth.)

6028. Dodd, J. M. (Dept. of Zoology, Univ. of Leeds, Yorkshire, England), and J. N. Dent. 1963. THYROID GLAND AND TEMPERATURE TOLERANCE RELATIONSHIPS IN COLD-BLOODED VERTEBRATES. Nature, Vol. 199, No. 4890, p. 299.

The findings give support to the view that hypofunction of the thyroid gland of the minnow does not enhance the ability of the fish to withstand exposure to lethal and sub-lethal temperatures under the conditions described.

6029. Biven, Donal'd A. 1961. THE DISTINCTION IN THE CHARACTER OF SCALES OF SIBERIAN SALMON, ONCORHYNCHUS KETA (WALB), OF THE FAR EAST AND ALASKA. Vopr. Ikhtiol. 1(1): 29-38; Referat. Zhur., Biol., 1963, No. 19I37; Biological Abstracts, Vol. 42, No. 5, Abst. No. 19961. 1963.

Material was collected in fresh waters of Alaska and Soviet Far East. Scales or their markings were projected by a microprojector MPR-1, and the external edge of each circulus along the length of the antero-lateral axis was recorded on a strip of paper. After this, the age of the fish, number of circuli in the first year of life, and the distance between the circuli in the second half of the first year was subdivided into 5 different zones and the average distance between the circuli was calculated for each zone. Most of the Siberian salmon in the northern part of the Pacific Ocean usually mature at 3 years. A lesser quantity living in their spawning rivers mature at 4 or 2 years. The difference in the number of circuli of the Siberian salmon of the Far East and Alaska was determined by the fact that the scales were taken from different parts of the body. In order to differentiate between the Siberian salmon of the Far East and Alaska, Sato's method was used, based on comparison of the average distance between the circuli in the 2nd half of the first year of life. Growth of Siberian salmon in the first year of life was studied in detail.

6030. Krayukhin, B. V. 1961. THE RELATIONSHIP OF THE METABOLIC RATE TO AGE AND WEIGHT OF FISH. (O ZAVISIMOSTI INTENSIVNOSTI OBMENA OT VOZRASTA I VESA RYB.) Byul. Inst. Biol. Vodokhranilishch Akad. Nauk SSSR 11. 42-43; Referat. Zhur., Biol., 1962, No. 15 I63; Biological Abstracts, Vol. 42, No. 5, Abst. No. 16678. 1963.

Oxygen consumption (OC) was studied in blue swordtail Xiphophorus sp. of 1 generation from the day of birth to 600 days of age. The OC rate of the fish of a single age, but different weight, varied considerably; it was higher in fish of a lower weight. Comparison of the coefficients of correlation between weight, age and OC indicated the somewhat greater dependency of OC on age than on weight.

6031. Mohsen, T., and C. Tourette (Fac. Sci., Dakar, Africa). 1962. THE ROLE OF THE THYROID GLAND IN THE HYDROMINERAL EQUILIBRIUM OF THE LEBISTES RETICULATUS PETERS (CYPRINODONTIFORMES: POECILIIDAE). (RÔLE DE LA GLANDE THYROIDE DANS L'ÉQUILIBRE HYDROMINERAL CHEZ LEBISTES RETICULATUS PETERS (CYPRINODONTIFORMES: POECILIIDAE).) Compt. Rend. Séances Soc. Biol. 156(7): 1338-1341; Biological Abstracts, Vol. 42, No. 5, Abst. No. 17494. 1963.

Analysis of the behavior of fishes transferred from sea-water to fresh-water with and without thyroxine and thiourea. (L. A.)

6032. Hela, Ilmo, and Taivo Laevastu (Inst. Oceanogr., Helsinki, Finland). 1961. THE INFLUENCE OF TEMPERATURE ON THE BEHAVIOR OF FISH. Arch. Soc. Zool. Bot. Finnicae "Vanamo" 15(1/2): 83-103; Biological Abstracts, Vol. 42, No. 5, Abst. No. 17941. 1963.

Literature on the influence of temperature on spawning, and on development and survival of larvae is reviewed. Attention is also paid to the temperature optima and the lethal temperatures for fish and to the influence of temperature on the distribution and abundance of fish. Present and future possibilities for finding fish concentrations by "thermometric methods" and the the prediction of abundance are discussed. (K. L.)

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Created in 1849, the Department of the Interior--America's Department of Natural Resources--is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

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